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**THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.**

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## Forthcoming Events.

OCTOBER 9.

*Institution of Welding Engineers*:—Ordinary meeting at Manchester. J. Ryder will read a Paper on "The Training of Operators in the Welding and Cutting Industries."

**Institute of British Foundrymen.**

SEPTEMBER 27.

*Newcastle-upon-Tyne Branch*:—Presidential address by A. Logan.

OCTOBER 4.

*Lancashire Branch*:—Opening meeting at Manchester. Presidential address by R. W. Stubbs.

OCTOBER 11.

*Lancashire Branch (Burnley Section)*:—Opening meeting at the Technical College, Burnley. "Belgian Moulding Sands in the Iron Foundry," Paper by F. Griffiths.

## The Building Trades Exhibition.

This exhibition, which is now being held at Olympia and which will remain open until October 1, makes an appeal to the foundry owner from a number of angles. Primarily, the larger foundries often carry out their own extensions, and for this class most of the exhibits carry matters of true interest. Then there are a number of exhibits devoted to woodworking machinery, the majority of which is applicable to the pattern shop; for instance, such well-known firms as Wadkin & Company, Sagar & Company, Thomas Robinson, Dominion Machinery Company, Limited, and Danckaert's Woodworking Machinery, Limited, have representative exhibits.

Whilst a large number of stove-grate foundries have taken space, we did not notice any cast-iron gutters, fall pipes and similar castings, but we did note that an exhibit of wrought stamped steelware covering these requirements was attracting a good deal of interest. We are aware that these are no particular novelty, in fact there was quite a vogue for them some 10 or 15 years ago, but the salesman on the Stand insisted that interest was reviving amongst builders and builders' merchants. Another potential competitive material to cast iron was a line of open steel flooring and stair treads, made by welding steel bars to form a latticework. It appeared to be a suitable construction as a grate for use in connection with the knocking out of castings, whilst allowing the sand to fall on to a conveyor belt.

Another type of foundry, represented by a few firms, was the comparatively small art brass- and bronze-castings manufacturer. One showed a line of imitation antiques, whilst others exhibited modern door furniture. Still further competition to the foundry is being made by treated resin products, which, apart from making quite artistic door furniture, do a large business in bathroom fittings. Some years ago materials fabricated from dried milk held the field, but personal experience of these products for bathroom fittings has convinced us of its short life due to excessive warping and unstable colouring. However, one salesman for the resin-based fittings told us that he had the contract for completely furnishing one of our modern liners with bathroom and door fittings.

The final interest for the foundry owner was the lesson to be learnt of display. Many founders have to solve the problem when exhibiting of making a show with bread-and-butter products of very ordinary appearance. For instance, the United Steel Companies, Limited, of Workington, were showing bars and steel plates, yet they had one of the most attractive and artistic shows in the whole Exhibition.

## On Spending Other People's Money.

The melancholy tale of failures in recent months of companies floated during a boom, amid prospectuses positively glowing with enthusiasm, has, we hope, taught the investor the dangers in promises of easy money. At one time the only men who took big risks with capital were men who had a good deal of it and who deliberately risked a portion of it for a prospect of a big return. The prospects were duly discounted in advance, of course. To-day, it seems easy for a group of men, totally inexperienced in an industry, to obtain large sums on a prospectus in which faith and hope are the main ingredients, based on some untried patent or secret process. Basic industries, bringing in a smaller return, are neglected. The public is also becoming alarmed at the light way in which many directors regard their responsibilities, in view of disclosures in various cases of men who signed on the dotted line because a powerful chairman issued instructions to that effect. This, and the use of shares as gambling and speculative counters, is the sort of thing that earns for business the contempt of professional and academic minds. It is made too easy to play with other people's money.

The same applies to local and national expenditure. A private individual earning a certain income knows what he can afford to spend. But our civic debts and national obligations can be met by the simple expedient of putting up the rates and taxes, with the result that there is no idea of what a municipality or the nation can afford to spend. It has become fatally easy for administrative officers to spend other people's money, and public control on finance both in the House of Commons and in the city and town councils, is not tight enough. We are often astounded at the sums granted by the House entirely without adequate discussion, because it is physically impossible as the House is now run to find time for it. Even then it is farcical, because much of the money called for has been spent already.

Many industrial firms have found salvation in a budgetary-control system, by which they fix for twelve months to come what they can afford to spend, and that amount is not exceeded. That system might be applied with advantage to local and national expenditures. The Budget would then have some significance as a name. At present, a budget is not a budget when it is a national Budget. Any individual can suggest ways and means of spending double his income with very desirable and admirable results. But he would soon be in the Bankruptcy Court. A nation or a community, as a collection of individuals, is subject to the same limitations.

## Correspondence.

***[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]***

### The Mystery of Cast Iron.

*To the Editor of* The Foundry Trade Journal.

Sir,—In your issue dated September 11 appears a leader, under above title, wherein occurs the following: "*One of the things which is becoming clear about cast iron is that composition is of comparatively minor importance, and enough evidence exists to-day to justify all composition clauses in specifications to be swept away. The heart of the foundry is the melting furnace and the melting procedure. There good raw material may be made poor in result or the best may be made of indifferent material.*"

The clarity claimed for the above "thing" needs to be compared with that of others. Let us take them one by one.

(1) A bad oven can spoil a good pie but a good oven cannot make a good pie of one which is either concocted wrongly or composed of unsuitable or adulterated materials.

(2) The ideal furnace for the ordinary ironfoundry is still the cupola.

(3) A controlled cupola reacts in a definite qualitative manner and to a definite quantitative degree upon the metals charged into it.

(4) The cast irons obtained from other types of furnaces are costly and have proved hardly, if at all, superior to those melted in a skilfully-worked cupola.

(5) The Lanz Perlit Process is founded upon combined considerations of compositions and temperatures.

(6) Those who have taken up the Lanz Perlit Process have stated that the benefits received from their study of it have been widespread over the whole of the cast irons made by them, whether Lanz Perlit or ordinary.

(7) Given the composition—namely, the total carbon, graphitic carbon, silicon, phosphorus, sulphur and manganese contents—of a selection of any brands of pig-irons available in this country, an experienced ironfoundry metallurgist is able to manufacture from them high qualities of Diesel cast irons, produced by the ordinary, the Lanz Perlit or any other process.

(8) When the writer visited, this year, some fifteen important foundries not connected with one another and situated far apart in Germany, they were, without exception, working according to composition. Moreover, the products of those foundries ranged from the lightest iron castings the writer has seen, through motor cylinders, locomotive cylinders, electrical, hydraulic and brake work, up to very heavy pieces for large engines.

(9) The proper specification of high-duty castings can be accomplished *only* by the inclusion of full composition.

Tensile and transverse results do not indicate special properties and, owing to the impossibility of producing a test-bar of similar texture to that of the casting, will not indicate even the tensile and transverse strengths of the casting. The properties of resistance to attrition, to heat, to internal pressures, to sea-water or other corrodents, of liability to have internal casting stresses, to chill heavily where the metal meets denseners, to draw where there is a meeting of sections or where overheated cores occur, to porosity at vital places, to cracking under internal blows or under external impact, and many other properties are one and all attained (or avoided) by including composition in the specification, and there appears to be no alternative method.

(10) Instead of omitting composition, the position is that nothing will announce more clearly the progress of our foundry and of our engineering knowledge than will the inclusion of strict and comprehensive composition clauses in all important specifications.

At present it is possible for two or more foundries to comply with the same specification with entirely different qualities of iron—one can hardly conceive of anything more futile, yet that is the position obtaining throughout this country. If one told an inspector of castings that it does not matter whether Admiralty gunmetal analyses at 88 : 10 : 2 so long as it passes the tensile and elongation tests, he would, in polite language or otherwise, tell you what you know about it; on the other hand, he himself displays the same ignorance when dealing with cast iron.

(11) The foundryman making his own mixtures always works to composition. He may not know it, but a very small investigation into his methods reveals it as the outstanding fact.

(12) The properties of castings made of any of the ferrous or non-ferrous metals or alloys known to modern science depend upon the effects of the melting-, pouring- and mould-conditions upon the particular composition of the metal or alloy used; heat-treatment, drawing, rolling, etc., may follow, the effects of which depend also upon the composition of the material. That cast iron should be the one exception is unthinkable; indeed, the very opposite is the case, because cast iron is more influenced by its composition than is any other metal or alloy the writer can call to mind.

If, as now suggested, this is all so much hallucination, the fact remains that twenty years' study, combined with the practical metallurgical control of many different foundries, has not provided the writer with a single instance in favour of it. Therefore, it becomes of paramount importance that, before scrapping the work of half a lifetime, one should know what alternatives are offered. Up to now the writer's experience has been that the more he understood the meaning of composition the better he understood cast iron. Beyond all other metals are its varieties of composition affected by mould-thickness, mould-conductivity, mould-temperature and mass-action.

Beyond all other metals are its test-bars difficult to produce with any true relation to the castings they represent. Some years back there was made a type of 18-ton iron containing at least 3.8 per cent. total carbon.

Its separately-cast test-bars were splendid; its cast-on test-bars were very good, but the castings themselves were deficient in those very qualities which their service conditions demanded. It was pearlitic iron, too—but not Perlit iron.

How are we to progress in our foundries, in our laboratories and in our Diesel and other modern engineering if we wipe out composition from our specifications and treat it as being of comparatively minor importance to our operations, is a question to which the author has but one answer, namely, that to do so would put us thirty years behind the times, effectively quench our chances of competing with our Continental friends and make us the laughing-stock of the scientific world.

Your leader concluded by saying "*We shall look forward with confidence to the production of irons of given properties with the same certainty and regularity and uniformity obtained with the simple metals and alloys.*"

Having had long experience of the scientific control of non-ferrous foundrywork, as well as of grey-iron work, the writer can state positively that a controlled iron foundry can produce as certainly and as regularly cast irons if given properties as a controlled brass foundry can produce gunmetals of given properties. The brass-founder is accustomed to having to work to composition, the ironfounder is not—which is the reason why cast iron has come to be classed as an unreliable material of varying composition and, therefore, of varying quality.—Yours, etc.,

Horace J. Young.

3, Central Buildings, London, S.W.1.
September 18, 1930.

## Random Shots.

Founding steadily forges ahead. At a Belgian musical festival, held at Liége, the first performance took place of a piece called "Steel Foundry," by Mossolov. It was said to be noisy but brilliant. We have no doubt it was full of sparkle. And a musical critic was doubtless quite innocent of punning when he said it showed a "crescendo piling-up of patterns." Perhaps the noise was due to the patterns falling down again!

* * *

Why bother about an international language? If foreign orchestras go on singing the vocal accompaniments to jazz tunes in English, everybody will know the language in a year or two.

* * *

The announcement that a census is to be taken in Great Britain in 1931 reminds me of some funny consequences of census-taking in America, where the fifteenth ten-yearly census has just taken place.

* * *

In one town the census enumerator solved the problem of the lady's age by looking at her face and adding twenty years. She was usually so horrified that she blurted out the truth. They say it worked every time.

* * *

One embarrassed father could not remember the ages of three of his seven children, and another bashfully suggested, "If you come round in a week I'll have another name to give you." In another place the enumerator found a farmer slept in a bed the pillow of which was in one county and the foot in another. The farmer was assigned to the former county on the rule that "heads shall be counted in their usual place of abode," although the heads referred to heads of families!

* * *

Another family, torn by dissension for three weeks about a name for a new baby, hurriedly made a hasty choice of a name while the enumerator waited. In Chicago three gunmen announcing themselves as enumerators, got in and robbed a home. Another enumerator could not get in because the lady of the house thought he was a burglar, and had to take the policeman on the beat along with him.

* * *

Surely one of the most elaborate hoaxes ever perpetrated on a London daily was reported this week. This is an alleged invention to double the mileage per gallon of motor-cars, fitted by "an average mechanic to any car" in half an hour. The device consists of a metal-barrel condenser no larger than a wooden cotton reel and a superheater no larger than the barrel of a fountain pen!

* * *

Steam from the radiator is sucked through the condenser to the superheater and passes thence with the fuel to the combustion chamber of the engine. The steam heats the fuel and smashes it up to an "almost perfect state of atomisation."

* * *

We are told that the first tests were made by using in the engine sump a mixture of half water and half lubricating oil! This was during the war, and both "Britain and America treated the discovery as a military secret of the first magnitude." It has certainly taken a long time (twelve years) for the secret to escape to the eagerly developing motor industry! Meanwhile more authentic news continues to chronicle the progress of the fuel-oil Diesel-type engine for cars and lorries.

Marksman.

# Automatic Sand Plants.

By E. V. Ronceray (Vice-President of the Association Technique de Fonderie).

The question of so-called automatic sand plants has attracted the interest of the public for some considerable time and is still to the forefront of the foundry world. These plants generally consist of various types of sand-preparing apparatus, placed near to each other and connected by some transporting apparatus. The original German type of sand plant, several sets of which were supplied to various foundries before the war, was based upon the principle of drying the new sand, then pulverising it and eventually incorporating it with the old sand which had been previously dried by a simple mixing arrangement. Actually, this sand plant, besides being very complicated, was not at all automatic, since the mixing was of such a crude nature that it produced work in a discontinuous manner in varying quantities, which differed not only in the mass produced, but also in the composition and quality of the various sands. The economic principle of working of moulding sands, however, was not properly followed. It may be definitely stated that the simple mixing of sands is not sufficient in order to obtain a complete covering of the silica sand grains with the clay and other agglomerating agents in the moulding sand. An energetic rubbing of the sand is essential, and this was not provided in these pre-war German plants. It is by rubbing the sand that the old-time moulder incorporated the new sand with the old sand. This was sometimes done by working with the feet, sometimes by means of a roller or by paddles of various kinds, or with cylinders revolving at different speeds, or, again, by spherical cages or balls and finally by modern mullers. One definite point of importance has been demonstrated in the tests on preparing sand, and that is that by preliminary drying the sands actually lose a good quantity of their qualities.* It is, therefore, desirable to avoid this preliminary drying of the sand and to find, if possible, some means of incorporating the old sand with the new sand without previous drying. The incorporation is quite difficult, but if it is possible the results are very much better. It is, moreover, nearly always under these conditions that the rubbing machines mentioned above carry out their work. These rubbing machines, which work very satisfactorily, present, however, certain inconveniences. The first is that the human factor plays a great part in the preparation of the sand. In the first case, the preliminary mixing of the sands may contain more or less regular proportions. Secondly, the damping of the sand may be inadequately carried out. The quantities of sand worked at any one time may be more or less, according to the inclination of the operator. The time the sand stops in the machine may be long or short. The regulation of the machine may be more or less well controlled, and, finally, the quality or quantity of the sand treated may vary very widely. The man operating the plant is obviously far from being negligible either in the sand plants, whether designated automatic or semi-automatic, because the management represents, very often, a most important factor. Again, the very small production of the apparatus normally available to the industry at the moment does not comply with the conditions of continuous-casting installations and does not treat sufficient quantities of sands to merit their inclusion in a continuous-casting plant.

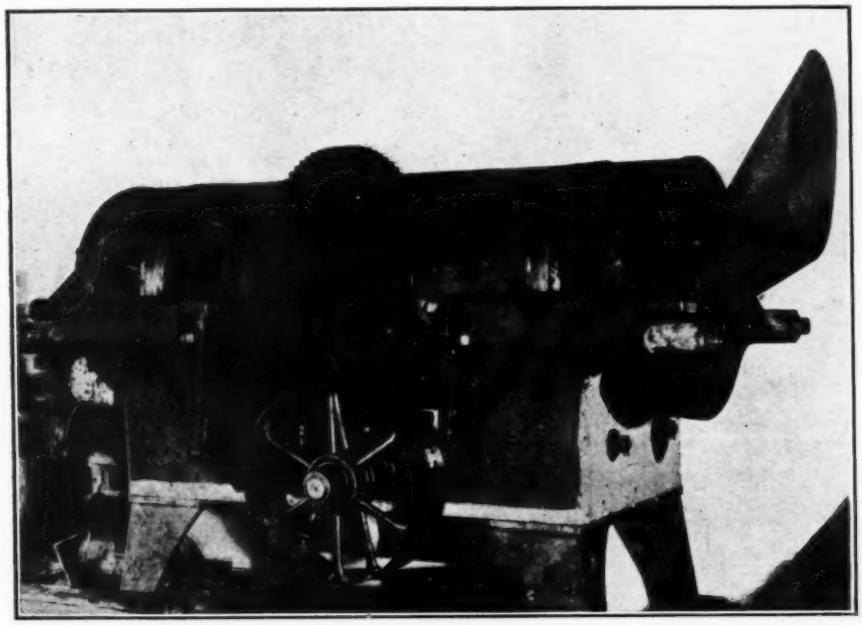

FIG. 1.—THE INCLINED-DRUM SAND MIXER DUE TO SAILLOT.

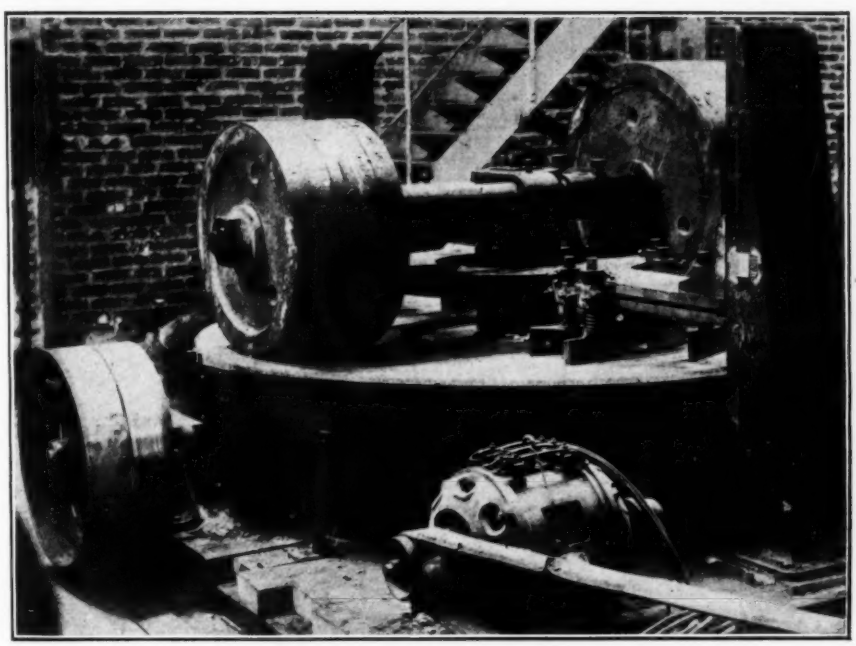

FIG. 2.—A SECOND ATTEMPT IN THE DEVELOPMENT OF THE SAND MILL.

### Maintenance Costs.

Again, it is quite easy to make the reproach on such apparatus, namely, that after a very short time of service, their efficiency diminishes owing to the difficulty to maintain them in a satisfactory state of repair. Thus sand mills, particularly those incorporating ploughs, suggest themselves for criticism. The ploughs are very easily worn and eventually the sand is not returned over or cut at each of its passages past the plough. The sand mill with the two rollers, one smooth and the other grooved, arises because the grooved rollers have been put in in order to replace the action of the ploughs which do not operate, but it must not be forgotten that by doing this the rubbing of the sand so treated is reduced by half.

Very careful tests have been made† with a hand roller, in order to try out whether the rubbing of sand is capable of covering the grains of silica with the clay constituent. If this test is taken to the extreme, it is possible, with a perfectly pure white silica sand and with a yellow moulding sand, like Fontenay sand, for example (Fontenay sand is a very strong-bonded sand generally used for casting in white metal, its clay content being very high), to obtain all the virtues of cohesion. A simple mixing does not give any cohesion at all. Rubbing the sand for a progressive period gives increasing cohesion up to a maximum. The apparatus recommended by the Commission on Sands, appointed by the

* Lemoine, "The Scientific Study of Sand," First A.T.F. Congress. 1928.

† The tests made in 1927 by the author at Philadelphia, before numerous specialists, have created great interest in America. Messrs. H. M. Lane and E. H. Mumford have related this at different times and under different circumstances, and it is from this epoch that the rubbing of sands and consideration of this point have commenced in America. The properties of this method of treating were totally unknown before this date.

American Foundrymen's Association, demonstrated these facts in a definite manner. It is remarkable to see the cohesion of the sand augment and the incorporation of the various ingredients carried out progressively. After a certain period of working, it is impossible to distinguish the different colours of the two original sands, and when the mass has reached its final colour, a maximum cohesion between the silica grains and strong Fontenay sand, is actually accomplished.

### Early Attempts.

An apparatus for rubbing sands has existed for a long time in Europe. It is capable of producing perfect results and bringing sands to an extremely good condition. The only difficulties which can be cited against this type of apparatus are the following:—(*a*) Their intermittence; (*b*) their irregularity, due to the human factor; (*c*) the difficulty of maintaining them in good condition, the ploughs never being in good state; and (*d*) their very low production.

It is with a view to solving these complicated problems that the author's firm has recently perfected an apparatus which it is proposed to describe. It is the final result of long tests which have stretched over a period of 20 years. The older foundries which are existing to-day will remember the inclined-drum invention (Fig. 1) by Monsieur Saillot, and the interior of

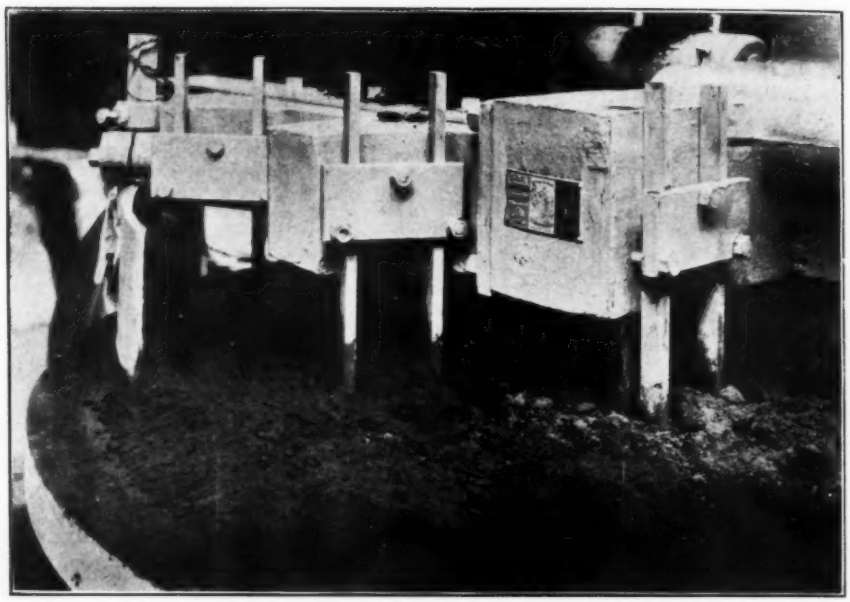

Fig. 3.—Showing the Action of the Cutting Blades in the Most Recent Type of Mill.

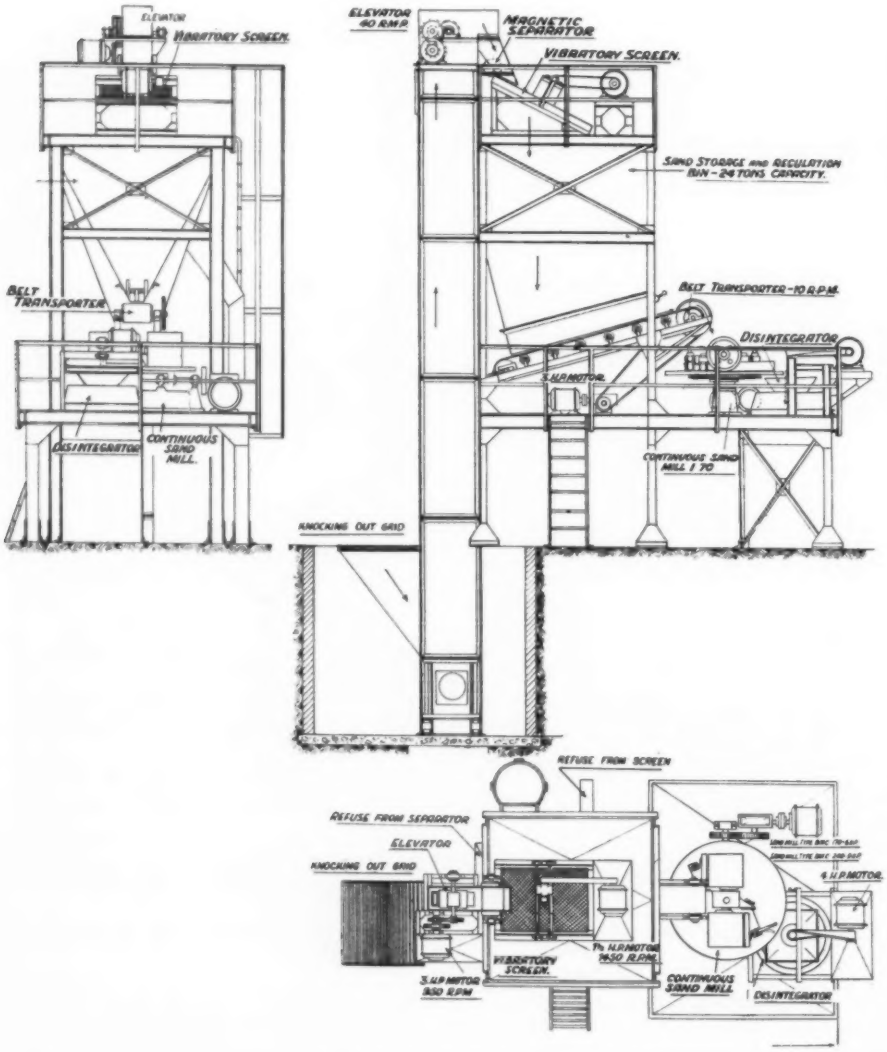


Fig. 4.—Lay-out for an Automatic Sand Plant of a Simpler Character for Discharging into Barrows or Conveyor.

this drum was fitted with rollers of different diameters and put on the market about 1907. The preliminary mixing chamber was situated at the charging end of the apparatus. The sand passed into the working chamber, where the rubbing was made. A scraper, with automatic arrangements for taking up the play, collected the sand from this first chamber and took it under the rubbing rollers, where it recommenced the cycle of operations.

As a result of the inclination of the drum, the sand descended little by little towards the exit, from whence it fell into a riddle or a disintegrator, which finished the work. It is interesting to note that several of these machines are still working in a number of foundries. They make very good sand, but present two difficulties. The first difficulty is that the production is too small, and the second that an accidental displacement of the rollers means that the whole apparatus has to be taken to pieces—a fairly tiresome proposition.

### Later Developments.

The sand mill, with two narrow and high rollers (Fig. 2), and having a continuous automatic delivery into a circular collector trough, was made later on. The working of the mullers in this case was copied from the usual sand mills on the market, but was found not to give a sufficient kneading on the sand. If Fig. 2 is examined, it will be noticed that the two mullers, being at different distances from the centre of the plate, utilise all the surface working of the plate. The mullers themselves are connected and can be made to rise and fall according to the thickness of the sand being treated. The line of cutting knives is mounted on a traverse fixed at both ends to two uprights, which in turn is fixed to the base, but this arrangement results in two drawbacks:—(1) The access to the centre of the mill is rendered difficult, especially for feeding, and (2) the knives or cutting blades, being in line, are often an obstacle to the passage of the cakes of sand and thus tend to provoke accumulation of sand between the cutting blades, which are fixed.

The sand obtained with this apparatus, however, was of good quality, but the production did not reach expectations, being only 4 to 5 tons of sand per hour. Later tests resulted in an enlarging of the mullers in order that they might occupy a larger proportion of the area diameter of the plate, so that the rubbing of the

sand was much more effective. The scrapers working on the face of the mullers resulted in the keeping of the face of these mullers relatively clean. If these scrapers were omitted, difficulties would arise with certain types of sand through sticking to the face of the mullers. The circular collecting trough was suppressed in this latter type, since the emptying of the mill was effected by scrapers, placed in a convenient position so as to collect the sand from the plate after milling, without any appreciable quantity falling off. The cutting blades (Fig. 3), instead of being in one line, were supported in three pairs in bearings fixed on the supports bolted to the pivot of the mill, thus leaving access to the entire apparatus extremely easy. This arrangement completely overcame the accumulation of sand, which reduced the production in the previous type of mill, and the discharging of the latest design is now extremely efficient. Recent tests have shown that it is quite possible with this type of mill to produce 12 to 15 tons of properly prepared moulding sand per hour, the production, of course, being dependent upon the speed of feeding the sand into the mill. One can increase this tonnage by increasing the rate of feeding, so that the sand does not remain for so long a time in the mill.

Fig. 3 shows the functioning of the knives or cutting blades on the cake of sand, which has just come from beneath one of the rollers. Figs. 4 and 5 show the facility with which one of these sand mills can be included into an automatic sand plant. The regular feeding of this mill is made by a metallic plate conveyor. It is also very simple to include this new sand mill into a continuous-casting installation. Figs. 4 and 5 show two arrangements of this description, which have been selected because one has recently been put into operation in France and the other in England.

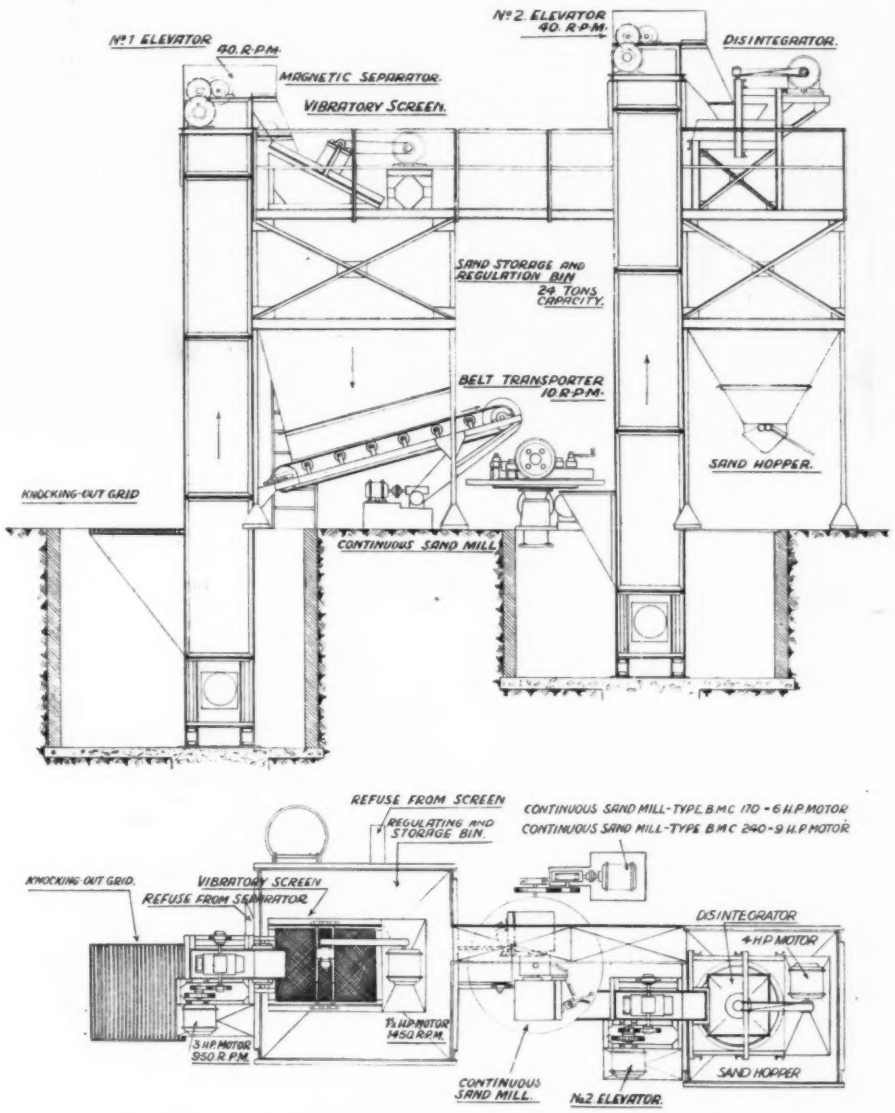


Fig. 5.—In this Sand Plant the Sand is Discharged into a Hopier.

## Belgian Founders Decorated.

It is with real pleasure that we announce that His Majesty the King of the Belgians has decorated several prominent members of the Belgian Foundrymen's Technical Association.

Mr. Ivan Lamoureux is now a Chevalier of the Order of Leopold II; Mr. Gustav Masson a Chevalier of the Order of the Crown; Mr. L. Piedbœuf a Chevalier of the Order of Leopold; Mr. H. Proyard a Chevalier of the Order of the Crown; and Mr. J. Varlet a Chevalier of the Order of Leopold II. We feel sure that these gentlemen, who have all created for themselves international reputations as foundry technicians of the highest order, will deserve the honours which have been bestowed upon them.

## Book Reviews.

**Kelly's Directory of the Engineering, Hardware, Metal and Motor Trades, 1930.** Published by Kelly's Directories, Limited, 186, Strand, London, W.C.2. Price 45s. post free.

The ground covered by this directory is England, Scotland and Wales. It has considerable interest for our readers, as they will find therein lists of users of the products, whether they are catering for the motor-car industry or the electrical trades. The lay-out of the directory is to give (1) the names for each county, arranged alphabetically under the towns and villages; (2) an alphabetical classification of the trades in the London postal area, and (3) a similar classification of trades for the rest of England, Scotland and Wales. At the moment directories present better value than ever owing to the recent great changes which have affected the development of industry such as the migration south, amalgamations and reorganisations.

**Impurities in Metals: Their Influence on Structure and Properties,** by Colin J. Smithells. Published by Chapman & Hall, Limited, 11, Henrietta Street, Covent Garden, London, W.C.2. Price 18s. net.

The first edition of Dr. Smithells' book appeared in July, 1928, and was reviewed at length by "A. B. E." in our issue of May 16, 1929. The second edition has since been thoroughly revised and brought up to date by the inclusion of much new data, although the general arrangement of the book remains unaltered. Chapters I and II are devoted to methods of studying the structure of metals, including that of X-rays. In the two following chapters the structure of pure metals and of alloys is discussed, the author dealing with cast, worked, annealed and electro-deposited metals. The influence of minor constituents on structure is next dealt with, Chapter V mainly concerning metallic constituents and Chapter VI non-metallic constituents. In this last chapter the section dealing with gases has been much enlarged and now occupies a matter of twenty or more pages. Thus in the paragraph headed "Chlorine Treatment" on page 113, reference is made to the Paper read by Mr. N. C. Ashton at the last session of the Lancashire Branch of the Institute of British Foundrymen. The chapter on "The Influence of Minor Constituents on the Mechanical Properties of Metals" has been entirely rewritten and considerably expanded. Whilst the original line of thought has not been changed, the mass of data connected with the effect of metallic constituents on mechanical properties has been summarised at the end of the section to facilitate reference. The two remaining chapters are devoted to the influence of minor constituents on the electrical properties and on the corrosion of metals. The book is well indexed and contains 181 illustrations and 190 pages.

## Proposed Glasgow Exhibition.

A letter suggesting that Glasgow should sponsor an exhibition incorporating the shipbuilding, engineering and allied trades has been sent to the Glasgow Chamber of Commerce by a Glasgow firm. It is pointed out that it is now ten years since these trades were represented at an exhibition. The suggestion has been carefully considered by the President's Advisory Committee of the Directors of the Chamber, who decided that the views of the Clyde Shipbuilders' Association and North-West Engineering Trades Employers' Association should be obtained.

The Glasgow Chamber of Commerce Special Committee is considering the publication of a brochure directed towards the stimulation of trade in Glasgow and the West of Scotland. The contents would bring before the country the advantages of the district as a manufacturing and exporting centre and advertise to the world the merits of the manufacturers of the district.

# A Novel Mould-Drying Stove.

On a recent visit to Messrs. Kryn & Lahy (1928), Limited, of Letchworth, we followed the working of the second test of a mould-drying stove which had been converted by Messrs. Thomas E. Gray & Company, Limited, of 119, High Holborn, London, W.C.1, to utilise the Herrmann system. Whilst this method is new to Great Britain, we are informed that 600 installations are in operation on the Continent. The arrangement of the stove inspected is shown on Fig. 1. The capacity of the stove is such that it takes between 30 and 40 tons of moulds. Unfortunately no standard is available for comparing the efficiencies of such types of furnaces, as density of ramming, moisture content, shape of mould and the degree of dryness insisted upon by those in charge constitute too many variables. Thus we propose to describe the Herrmann system, and then detail the performance of the first two trial runs and finally to give in general terms our personal opinion of the underlying theory and of the results so far achieved.

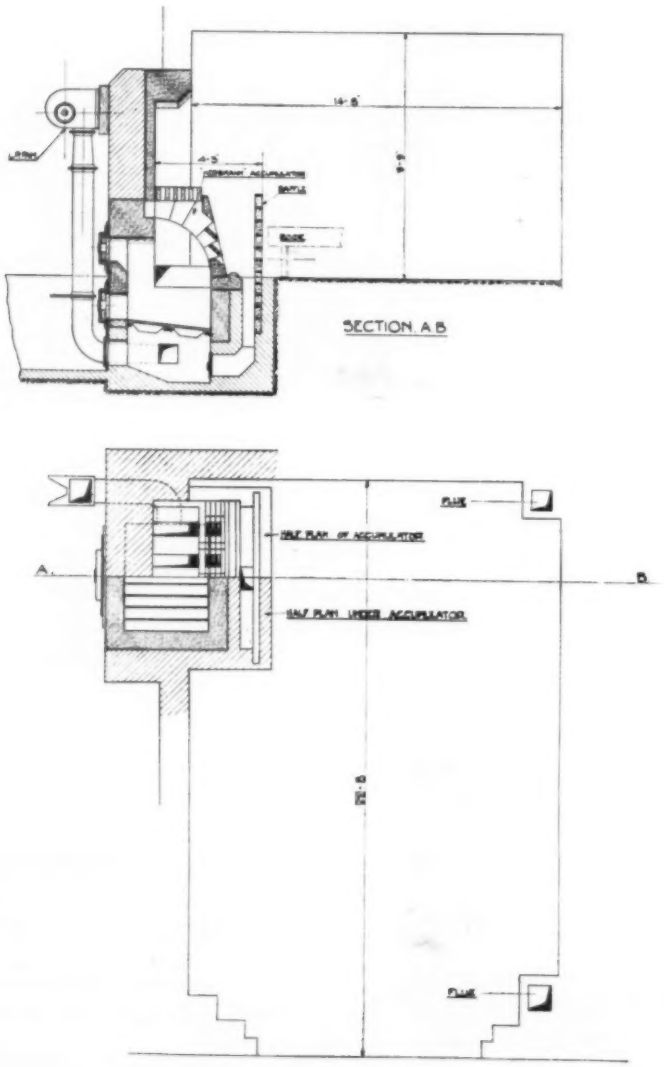


Fig. 1.—A Herrmann Furnace Installation at Messrs. Kryn & Lahy.

### The Herrmann System.

The design of the Herrmann system is characterised by the inclusion of a heat accumulator which is interposed between the fire box and the drying chamber. This accumulator is so constructed that it offers to the hot gases from the fire box an extremely large surface area for the rapid absorption of heat, whilst at the same time providing a heavy mass of masonry for its retention. It is built of highly-refractory bricks in the form of a quarter-arch over the fire box, and the hot gases slowly permeating therethrough augment the heat being dissipated from the accumulator. The fire box incorporates the use of fire bars, specially designed for the combustion of low-grade fuel such as gas-coke, breeze, dust or waste from the foundry coke storage bins. It was this last-named fuel which was being used at the tests at which we were present. Air for combustion is provided by a low-pressure fan blowing beneath the fire bars.

### Method of Working.

The fire was lighted at 8.30, using 2 cwts. of coke as fuel. Then, when the bed was incandescent at 10 o'clock, the fan was switched on. The temperature, taken near the door flue on the side opposite the accumulator, was 220 deg. C. At 12.15 the blast was stopped, and the pyrometer reading was then 320. Table I shows the fall in temperature from this time onwards:—

Table I.—*Temperature Fall in Herrmann Stove.*

| Time. | Temperature. |
|---|---|
| 12.30 | 250 |
| 12.45 | 220 |
| 1.45 | 200 |
| 2.45 | 180 |
| 3.30 | 170 |
| 4.30 | 160 |
| 5.15 | 155 |

The fuel consumption was, in addition to the 2 cwts. of coke, 6 cwts. of breeze. The stove was opened at 5.15, and the 30 tons or so of moulds therein were dried to the satisfaction of the foundry foreman. About 3 in. beneath the surface of a large mould the temperature was 130 deg. C. Table II is reproduced as a matter of interest. It shows the thermal history of the first test, at which we were not present:—

Table II.—*First Test on the Herrmann Furnace.*

| Detail. | Time. | Temperature. |
|---|---|---|
| Fire lighted .. .. | 12.30 | — |
| Blast on .. .. | 2.45 | — |
| Blast off .. .. | 5.15 | 380 |
| .. .. .. | 5.30 | 320 |
| .. .. .. | 6.30 | 260 |
| .. .. .. | 7.30 | 240 |
| .. .. .. | 8.30 | 230 |
| .. .. .. | 9.30 | 220 |
| .. .. .. | 10.30 | 212 |
| .. .. .. | 11.30 | 205 |
| .. .. .. | 1.30 | 192 |
| .. .. .. | 2.30 | 184 |
| .. .. .. | 3.30 | 178 |
| .. .. .. | 5.00 | 172 |
| .. .. .. | 8.00 | 150 |

The foreman's remarks were that "the moulds were well dried and the boxes very hot at 9 a.m." The coke consumption was 4 cwts. and 4 cwts. of coke breeze.

### Underlying Principles.

Our own conception of the principle upon which the system is based is that it permits of the use of rapid combustion, with which is to be associated economy, as rate of input of heat units per unit of time is the governing factor, because dissipation of heat is constant and dependent on elapsed-time. Thus the fire can be stoked and burnt up as rapidly as possible, yet the moulds cannot be burnt because during this period the rapidly-generated heat is being absorbed by the accumulator, to be given up gradually and constantly over a reasonable working period, at no further expenditure of fuel.

It should be distinctly understood that this stove was only *modified* to incorporate the Herrmann system, and to our mind was far from ideal, as the front door is made of a single steel-sheet arrangement. This obviously allows a rapid dissipation of heat and to some extent nullifies the benefits to be derived from the accumulator. However, plans are under way for modifying and lagging the doors, after which we confidently expect the cooling curve of the furnace to be appreciably retarded.

We express our indebtedness to the directors and staff of Messrs. Kryn & Lahy and Messrs. Thomas E. Gray for their co-operation and the facilities accorded to us during the tests.

**Machining High-Chromium Steels.**—According to "Steel," a disadvantage of corrosion-resisting steels having high-chromium contents has been difficulty in machining. Recently it was discovered that an addition of about 0.40 per cent. zirconium sulphide greatly facilitated machining and helped grinding and polishing.

# THE IRON AND STEEL INSTITUTE.

## AUTUMN MEETING IN PRAGUE, CZECHO-SLOVAKIA.

The Autumn Meeting of the Iron and Steel Institute opened on Monday, September 15, at the Institute of the Society of Czecho-Slovak Engineers in Prague under the Presidency of Prof. Henry Louis. Nine different countries were represented. Great Britain was represented by over 140 delegates, Sweden by nine, France nine, Spain seven, Germany five, Austria four, Norway two, while the United States, Japan, Rumania and Bulgaria sent one representative each. Dr. Matousek, speaking in the name of the Czecho-Slovak Government, welcomed the delegates, and PROF. H. LOUIS replied. In the afternoon a reception was held at the British Legation.

INSTITUTE OF THE SOCIETY OF CZECHO-SLOVAK ENGINEERS AT PRAGUE.

### Reception Committee.

The Patron is HIS EXCELLENCY DR. JOSEF MATOUSEK (*Minister of Commerce, Industry and Trade*), and the General Reception Committee included the following, among others:—

His Excellency JOSEPH ADDISON, C.M.G. (*British Minister in Prague*). Dr. FRANZ BACHER (*President, Association of the German Press in Czecho-Slovakia*). Dr. KAREL BAXA (*Lord Mayor of the City of Prague*). Mr. JAN CERNY (*Ex-Prime Minister, President of the Provincial Government in Brno*). Ing. JACQUES CHANZY (*Manager, Union Européenne Industrielle et Financière; Director, Czecho-Slovak Mining and Ironworks Corporation, and Skoda Works*). Ing. BOHUMIL CLUPEK (*Ministerial Councillor in the Office of the President of the Republic of Czecho-Slovakia*). Ing. EDWARD CZEIKE-ZENTZYTZKI (*Manager, Prague Iron and Steelworks Company*). Ing. Dr. ALOIS CZERMAK (*Managing Director, Zapado Cesky Bansky Spolek (West Bohemia Mining Co.), Usti nad Labem*). Ing. Dr. ALOIS EMIL DOBNER (*Manager, Vitkovice Mines, Steel and Ironworks Corporation*). Dr. VOJTECH DOLEJS (*Police President*). Ing. K. DOMES (*Chairman, Hauptverein deutscher Ingenieure (Society of German Engineers) in the Czecho-Slovak Republic, Brno*). Mr. JAN DROBNY (*President of the Provincial Government in Bratislava*). Dr. OTTO FEILCHENFELD (*President, Poldi Steel Company; Director, Bohemian Discount Bank*). Ing. Dr. JULIUS FIEDLER (*Rector Magnificus of the German Technical University, Prague*). Ing. FRANTISEK FRANZ (*Manager, Vitkovice Mines, Steel and Ironworks Corporation*). Ing. KAREL GALLER (*Managing Director of the Czech Commercial Federation, Usti nad Labem*). Mr. RUDOLF GUTMANN (*Ironmaster and Mine-owner*). Mr. WILHELM GUTMANN (*Ironmaster and Mine-owner, Prague*). Mr. WOLFGANG GUTMANN (*Mine-owner, Orlova Lazy Mines*). Ing. Dr. THEODOR HAERTL (*Manager, Vitkovice Mines, Steel and Ironworks Corporation*). Ing. Dr. JOSEF HAVRANEK (*Chief Technical Manager, Skoda Works*). Dr. F. X. HODAC (*Member of Parliament, Professor at the Czech Technical University, General Secretary of the Federation of Czecho-Slovak Manufacturers*). Ing. Dr. ZDENKO HOROVSKY (*Member of the Board of the Prague Iron and Steelworks Company*). Ing. ANTON HOEDL (*Managing Director, Prvni Brnenska Strojirenska Spolecnost (First Brunn Engineering Works Company), Brno*). Ing. LUDVIK KIRSCHNER (*Rector Magnificus of the Mining and Metallurgical College, Pribram*). Mr. OTTO KLESPER (*Managing Director, Mannesmann Works, Chomutov*). Ing. Dr. OTAKAR KRULIS-RANDA (*Managing Director, Czecho-Slovak Mining and Ironworks Company*). Ing. Dr. ANTONIN KRIZ (*Manager, Skoda Works, M.I.S.I.*). Mr. HUGO KUBAT (*President of the Provincial Government in Prague*). Dr. JAN LARISCH-MOENICH (*Mine-owner, Karvinna Solca*). Ing. AIME LEPERCO (*Chairman, Czecho-Slovak Mining and Ironworks Company; Managing Director, Union Européenne Industrielle et Financière, Paris*). Ing. VLADIMIR LIST (*Professor at the Czech Technical University, Brno; Chairman, Czecho-Slovak Standards Association*). Dr. KAREL LOEVENSTEIN (*Managing Director, Skoda Works*). Ing. KAREL LOEWL (*Privy Councillor, Works Manager, State Steel and Ironworks, Podbrezova, Slovakia*). Mr. JOSEF MAREK (*President, Editors' Club for Political Economy*). Dr. VACLAV MARES (*Representative of the Czecho-Slovak Mining and Ironworks Company*). His Excellency M. JAN MASARYK (*Czecho-Slovak Minister Plenipotentiary and Envoy Extraordinary to the Court of St. James*). Ing. Dr. A. N. MITINSKY (*Professor at the Mining and Metallurgical College, Pribram, M.I.S.I.*). Ing. EMIL MODR (*Mines Manager, Czecho-Slovak Mining and Ironworks Company*). Ing. Dr. Techn. OTTO MULACEK (*Managing Director, Poldi Steel Company*). Ing. GUSTAV MULLER (*Manager, Skoda Works*). Ing. LADISLAV NOVAK (*M.P., Ex-Minister of Commerce, Industrialist*). Dr. JOSEF PAZOUREK (*Rector Magnificus of the Czech Technical University, Prague*). Mr. JIRI PICHL (*Senator, President of the Syndicate of Journalists*). Ing. Dr. FRANTISEK PISEK (*Rector Magnificus of the Czech Technical University, Brno, M.I.S.I.*). Mr. IGNAZ PETSCHEK (*Ironmaster and Mine-owner, Usti nad Labem*). Dr. OTTO PETSCHEK (*Banker and Mine-owner, Prague*). Ing. Dr. FRANTISEK POSPISIL (*Managing Director of Coalmines of the Ferdinand Northern Railway, Moravska Ostrava*). Dr. JAROSLAV PREISS (*President, Federation of Czecho-Slovak Manufacturers; Managing Director, Zivnostenska Banka in Prague; President, Sales Office of the Associated Steelworks of Czecho-Slovakia*). Dr. HANUS RINGHOFFER (*Managing Director, Ringhoffer Works*). Mr. CHRISTOPHE H. ROCHEITE (*General Manager, Skoda Works*). Mr. EUGEN ROTHSCHILD (*Banker, Ironmaster and Mine-owner*).

PROF. HENRY LOUIS, M.A., D.Sc., A.R.S.M., M.Inst.C.E.
(*President of the Iron and Steel Institute*).

DR. V. SYKORA
(*President of the Society of Czecho-Slovak Engineers*).

ING. J. LUBINA
(*Director and Secretary of the Society of Czecho-Slovak Engineers*).

Baron Louis Rothschild (*Banker, Ironmaster and Mine-owner*). Ing. B. Rosenbaum (*Director of the Czecho-Slovak Standards Association*). Ing. Klement Ruzicka (*Managing Director of the Ceskomoravska-Kolben-Danek Engineering Works, Prague*). Dr. Premysl Samal (*Chancellor to the President of the Czecho-Slovak Republic*). Mr. Eugene Schneider, Sc.D. (*President, Union Européenne Industrielle et Financière; President, Czecho-Slovak Mining and Ironworks Company; Past-President and Bessemer Medallist, Iron and Steel Institute*). Ing. Dr. Eduard Sebela (*Commercial Councillor and Managing Director of the Vitkovice Mines*). Mr. Josef Simonek (*Senator, President, Skoda Works*). Ing. Dr. Adolf Sonnenschein (*Managing Director, Vitkovice Mines, Steel and Ironworks Corporation; President, North Moravian-Silesian Industrial Federation, M.I.S.I.*). Ing. Karel Stauch (*Managing Director, State Mines and Ironworks; Councillor to the Czecho-Slovak Ministry of Public Works, Prague*). Mr. O. F. Steiner (*Chairman, Czecho-Slovak Chamber of Commerce in London, M.I.S.I.*). Mr. Max Steinthal (*Commercial Privy Councillor, President, Mannesmann Company*). Ing. Vladimir Stieber (*Works Manager, Skoda Works, M.I.S.I.*). Dr. Adolf Stransky (*President, Prague Iron and Steelworks Company*). Ing. Dr. Vladislav Sykora (*Managing Director, Prague Iron and Steelworks Company; President, Society of Czecho-Slovak Engineers*). Ing. George Thedrel (*Works Manager, Czecho-Slovak Mining and Ironworks Company, Trinec*). Ing. Dr. Jan Tille (*Manager, Czecho-Slovak Mining and Ironworks Company*). Ing. Dr. Emil Tranquillini (*Rector Magnificus of the German Technical University, Brno*). Mr. Fritz Weinmann (*Mine-owner, Usti nad Labem*). Mr. Hans Weinmann (*Mine-owner, Usti nad Labem*), and Mr. Jan Wilczek (*Mine-owner, Dobroslavice*). The Hon. Secretary is Ing. Josef Lubina (*Director and Secretary of the Society of Czecho-Slovak Engineers*).

### Executive Committee.

The Executive Committee consists of the following gentlemen :—

Ing. Dr. Vladislav Sykora (*Chairman*); Ing. Bedrich Rosenbaum (*Vice-Chairman*); Ing. Edward Czeike-Zentzytzki; Ing. Dr. Alois Emil Dobner; Ing. Frantisek Franz; Ing. Dr. Theodor Haertl; Ing. Dr. Antonin Kriz; Dr. Vaclav Mares; Ing. Gustav Mueller; Ing. Vladimir Stieber; Ing. Josef Lubina (*Hon. Secretary*).

### Members and Others attending the Meeting.

Messrs. E. de Aburto (Bilbao, Spain); A. T. Adam (Musselburgh); Dr. D. Adamson (Hyde, Cheshire); Messrs. G. R. Adamson (Hyde, Cheshire); H. Almqvist (Falun, Sweden); E. Andresen (Bergen, Norway); F. Appleyard (Sheffield); G. Wesley Austin (Greenock); G. Baker (Rotherham); S. E. Baker (Rotherham); E. Balmford (Manchester); H. C. Bickerton (Ashton-under-Lyne); E. M. Boote (Coventry); A. H. Bourn (London); Cyrus Braby (London); A. O. Bracke (Storfors, Sweden); Dr. A. Bramley (Loughborough); Messrs. J. Bucher (Paris); D. F. Campbell (London); H. E. Carter (London); L. Charbonnel (London); A. E. Chattin (London). *Assistant Secretary*; Colonel W. F. Cheesewright, D.S.O. (London); Messrs. A. de Churruca (Bilbao, Spain), *Hon. Vice-President*; B. Clasen (London); W. Cleland (Sheffield); T. P. Colclough (London); H. E. Cookson (Birmingham); M. le Comte de Cosse Brissac (Paris); Messrs. B. D. Contodimos (Bulgaria); J. Craig, C.B.E. (Glasgow), *Vice-President*; D. Sidney Davies (Gateshead); V. Delport (London); M. Diaz Guardamino (Bilbao, Spain); Professor E. Diepschlag (Breslau, Germany); Mr. W. Dorrington (Birmingham); Dr. E. L. Dupuy (Paris); Dr. R. Durrer (Berlin-Charlottenburg); Messrs. P. A. Edmunds (London); R. Elsdon (London), *Librarian*; F. C. Fairholme (Sheffield); M. Fiala (Plzen, Czecho-Slovakia); L. G. Fokes (London); A. Fornander (Fagersta, Sweden); E. Fornander (Hagfors, Sweden); C. S. Gill (Sheffield); W. G. Girling (Newcastle-upon-Tyne); J. R. Glass (London); A. Glazunov (Pribram, Czecho-Slovakia); P. Gouge (Paris); O. F. Grazebrook (Dudley); Rudolf Ritter von Gutmann (Vienna); R. A. Hacking (Rotherham); A. B. Handley (Rotherham); F. W. Harbord, C.B.E. (London), *Past-President*; Dr. W. H. Hatfield (Sheffield), *Member of Council*; Messrs. J. Henderson (Scunthorpe, Lincs), *Member of Council*; G. Hethey (Eastbourne); A. P. Hinton (London); J. E. Holgate (Mostyn); C. E. Holmstrom (Sheffield); Barrington Hooper, C.B.E. (London); A. Hutchinson, M.A. (Saltburn-by-the-Sea), *Vice-President*; H. Jeans (London); G. H. Johnson (Kettering); Wiking Johnsson (Stockholm, Sweden); P. Jump (Dudley); J. S. Kerr (Manchester); H. Kershaw (Prague), *Commercial Secretary, British Legation*; H. S. Knowles (Manchester); E. Kockum (Ronneby, Sweden); Dr. A. Kriz (Plzen, Czecho-Slovakia); Mr. E. Kugel (Düsseldorf, Germany); Sir W. J. Larke, K.B.E. (London), *Member of Council*; Messrs. E. H. Larsson (Smedjebacken, Sweden); J. H. W. Laverick (Sheffield); R. Lemmy (London); R. T. Lintern (Rotherham); P. List (Barrow-in-Furness); Daniel C. Lloyd (Wolverhampton); F. N. Lloyd (Wolverhampton); G. C. Lloyd (London), *Secretary*; H. L. Lockley (Sheffield); F. A. B. Lord (London); Professor H. Louis, M.A., D.Sc. (Newcastle-upon-Tyne), *President*; Messrs. L. Loewy (Düsseldorf, Germany); J. Lubina (Prague), *Director of Society of Czecho-Slovak Engineers, Hon. Secretary*; The Hon. R. G. Lyttelton (London); Mr. A. D. G. McBean (Wolverhampton); Dr. A. McCance (Glasgow); Messrs. J. McNaughton (Leeds); F. S. Marsh (Chesterfield); B. Matuschka (Ternitz, Austria); T. A. Mills (Saltburn-by-the-Sea); Professor A. N. Mitinsky (Pribram, Czecho-Slovakia); Messrs. G. Monfort (London); A. O. Morgan (Briton Ferry); F. C. Moss (Rotherham); Colonel J. G. Needham, D.S.O., O.B.E. (Manchester); Mr. C. U. Peat (Middlesbrough); Professor M. F. Pisek (Brno); Messrs. F. Poboril (Plzen); R. Pound (London); F. H. Preece (London); Professor O. Quadrat (Prague); Messrs. R. Quijano (Santander, Spain); A. Regner (Prague); C. H. Ridsdale (Middlesbrough); David E. Roberts (Cardiff); Baron Louis von Rothschild (Vienna, Austria); Messrs. E. Rouer (Paris); G. A. V. Russell (Birmingham); de Saint-Sauveur (Paris); H. Sawamura (Aachen, Germany); J. Sarek (Kladno, Czecho-Slovakia); Eugene Schneider (Paris), *Past-President*; Professor Dr. Ing. E. H. Schulz (Dortmund, Germany); Messrs. R. Schwarz (Vienna, Austria); R. D. Sheard (Wakefield); H. Shillitoe (London); L. P. Sidney (London); D. Sillars (South Bank, Yorks); W. Simons (Cardiff), *Vice-President*; W. E. Simons (Cardiff); Frank Somers (Halesowen); F. J. Somers (Halesowen); W. L. O. Somers (Halesowen); Dr. A. Sonnenschein (Vitkovice); Messrs. A. Sprenger (Berlin, Germany); C. E. Squire (Sheffield); O. F. Steiner (London); J. W. Stewart (Glasgow); V. Stieber (Plzen); Professor Bradley Stoughton (Bethlehem, Pa., U.S.A.); Dr. Ing. V. Sykora (Prague and Kladno), *President, Society of Czecho-Slovak Engineers*; Professor C. C. Teodorescu (Timisoara, Rumania); Messrs. F. M. Thomas (London); H. Spence Thomas (Cardiff), *Member of Council*; H. B. Toy (Saltburn-by-the-Sea); S. V. Toy (Nunthorpe, Yorks); F. H. Treherne Thomas (Llanelly); Dr. R. Vondracek (Brno); Messrs. F. Walckenaer (Le Creusot, France); F. Y. Walters (Newcastle-upon-Tyne); H. Williams (Rotherham); A. B. Winterbottom (Birmingham); H. C. Wood (London); H. E. Wright (Middlesbrough); R. Zubiria (Bilbao, Spain).

### Election of Honorary Vice-President.

Prior to the opening of the technical session on Monday, September 15, Prof. H. Louis (President) announced that the Council had decided to ask Dr. Sykora to become Honorary Vice-President of the Institute, and hoped he would honour them by accepting.

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At a meeting of the directors of the General Electric Company, Limited, it was decided to make a new issue of debenture stock in order to redeem the existing stock.

## Aluminium Holding On.

By "Onlooker."

Amidst the welter of price reductions which have overcome the non-ferrous metals during the past twelve months, aluminium has survived the process of disintegration, and throughout the present year, when other prices have been crumbling sadly, the quotation has been maintained at £95. There is, of course, little doubt that those responsible for the fortunes of the white metal have taken very careful note of what has happened to copper, tin and spelter, and have come to the conclusion that price cutting is not always to be depended upon as an "order getter," and that a weak market, at a time when business is suffering as much as anything from adverse sentiment and lack of confidence, will suffer still more if a series of price reductions are put into operation. In any case, the European Consortium has put a bold face on the matter, and by nailing the flag of £95 per ton to the mast they are probably riding out the storm of the present trade slump as well as those producers who have slaughtered values in an attempt to encourage sales.

The disastrous ups and downs in copper prices, as well as the unduly exalted value put upon this metal during the past two years, have undoubtedly given aluminium a chance to supersede copper in many directions, and although the quotation of the latter has now fallen to a very low point, it is by no means certain, in view of the "ring fence" surrounding copper, that the change back will be a very sudden one. For one thing, there has been, and still is, quite a strong opinion that the price of aluminium will fall, and the ruling values for scrap and remelted ingots which have widened to a considerable differential below virgin notched bars, have lent colour to this idea. Really good-class wrought scrap is not very plentiful, but then demand has not been brisk; remelted ingots, however, have been pressed for sale, especially from the Continent. Cast aluminium has lately been almost a drug in the market, and consumers have received extraordinarily cheap offers from holders anxious to turn their stock into money. From this it will be evident that aluminium is suffering from slack trade conditions quite as much as the other metals. But, as already stated, the price in Europe has been maintained, and this in spite of some reduction in American values. Whether or not this policy will prove to be right remains to be seen.

As to details of production, the world total for last year at about 257,000 tons set up a fresh record, comparing with approximately 236,000 tons in 1928 and 210,000 in the previous year. The first year after the war saw a world production of 125,000 tons, which, with the exception of 1921 and 1922, has been steadily rising ever since, something like a hundred thousand tons per annum being added between 1924 and 1929. It is interesting to notice that supplies of aluminium are drawn in almost equal quantities from the new world and the old, Canada and the United States between them last year accounting for approximately 130,000 tons. A survey of output during the past ten years reveals the fact that this proportion has been maintained fairly regularly. The United States is, of course, the world's chief producer, her contribution last year being about 100,000 tons. In Europe, Germany leads with about 30,000 tons, France being a good second. Norway comes next at close on 27,000 tons, and then Switzerland with 21,500 tons, while British production has been steady at about 8,000 tons for some years.

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The two-monthly ascertainment for July and August shows that the average selling price of West Coast hematite pig-iron was £3 11s. 7.91d., against £3 15s. 5.18d. in the previous two months. Blast-furnacemen's wages fall by 4¾ per cent. to 24½ per cent. above standard.

# The Heterogeneity of an Ingot made by the Harmet Process.*

By Ant. Kříž, Dr. Ing. (Plzeň, Czecho-Slovakia).

*(Abridged.)*

This Paper is a report on the heterogeneity of a nickel-chromium-molybdenum steel ingot made at the steel plant of the Skoda Works at Plzeň (Czecho-Slovakia) by the Harmet process. With regard to the procedure of testing, the scheme outlined in the Reports on the Heterogeneity of Steel Ingots Committee of the Iron and Steel Institute was followed as closely as possible.

### The Harmet Process.

The installation for the Harmet process erected at the steel plant of the Skoda Works at Plzeň can be characterised by the following data: The inner section of the ingot mould is octagonal, with either plane or convex faces. The lower part of the ingot mould up to a height of from 35.4 in. to 47.2 in. (according to the size of the mould) has walls perpendicular to the base, the remaining part being conical. The diameter at the base is from 41.4 in. to 57.1 in. The height of the ingot mould is from 167.8 in. to 219.0 in., and the compressed ingots weigh from 12 up to 45 tons.

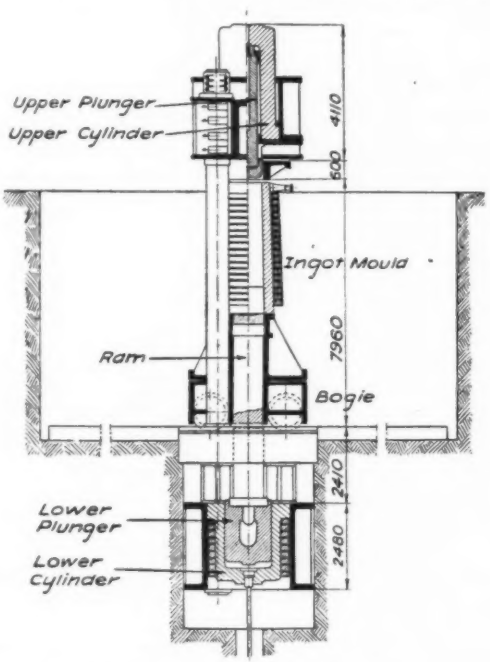


FIG. 1.—THE HARMET PRESS (DIMENSIONS IN MM.).

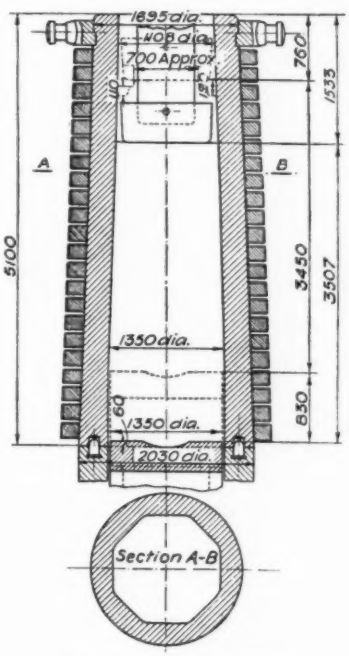


FIG. 2.—MOULD OF INGOT INVESTIGATED.

The bottom plate of the mould fits freely into the lower cylindrical section of the mould, and can be moved upwards (or lowered) by means of the ram of a vertical hydraulic press with a plunger 50 in. dia. (Fig. 1). The upper section of the mould allows a top plate connected with the plunger of the upper press to be freely lowered. The latter plunger is 26.4 in. dia. The top plate serves to exercise the necessary counter-pressure during the compression. The dimensions of the bottom and top plates are in accordance with the dimensions of the mould. The ingot mould is mounted on a bogie, through which passes the lower vertical ram. The bottom plate of the mould rests on the ram.

In order that steel may be poured out of the ladle the mould is moved out from under the press on the bogie. After the casting of an ingot the mould is moved back under the press. The total height of the press is 650 in., the distance between the lower ram in the lowered position and the lifted upper ram being 311 in. The maximum stroke of the lower ram is 52.4 in. and that of the upper plunger is 94.5 in. The compressed ingot may have a height of from 78.8 in. to 177 in. During the compression, the maximum pressure on the plunger of the lower cylinder that is attained is 790 atm.; that on the plunger of the upper cylinder is kept at 50 atm. The working pressure is produced by a three-piston hydraulic pump driven by an electric 50-h.p. motor, the pump being combined with an accumulator.

During the compression the bottom plate moves upwards in the cylindrical part of the mould and forces the solidifying ingot into the tapered part of the mould. The top plate serves at the same time to exercise a counter-pressure and to resist the formation of a "head." The side pressure that is exerted during the forcing of the ingot into the conical part performs the wire-drawing of the ingot. The compression being completed, the ingot is stripped by means of the upper plunger. The hydraulic pressure under the lower plunger is registered automatically, while the pressure in the upper cylinder is indicated by a manometer. The pressures are regulated by valves. The movements of the lower and upper plungers are also automatically graphed against time. The pressure is so adjusted that the movement of the lower plunger may be uniform and progress along an empirical curve traced beforehand. The compression lasts, in accordance with the size of ingot, from 4 to 7 hrs.

The casting temperature and the rate of teeming at the Skoda Works comply with the values normally used for the ordinary kinds of ingots. The compression is commenced from 15 to 60 min. after the end of teeming. This period depends upon the size of the ingot, its casting temperature and its rate of pouring. The larger the ingot, the higher the casting temperature, and the higher the rate of pouring, the longer is the period of waiting. The cooling of the mould by water is commenced as soon as the teeming is finished, water being delivered at the upper portion of the mould and trickling down the hoops which encircle it.

### Ingot Investigated.

The steel was made in an acid open-hearth furnace of 35 tons capacity. The time from the melting down of the charge to its tapping was 7 hrs. The procedure of the whole process was normal.

The chemical composition of the cast was determined by the analysis of a bar forged from the middle portion of a small test ingot of a total weight of approximately 7 kg.

The analysis was as follows: Carbon 0.31, manganese 0.55, silicon 0.18, phosphorus 0.028, sulphur 0.022, nickel 2.09, chromium 0.41, molybdenum 0.26 per cent. The shape and dimensions of the ingot mould used in this case are to be seen in Fig. 2. The lower cylindrical portion of the mould was 42.2 in. high. The remainder was tapered up to the top. The taper was 0.4 in. per ft. The mould was filled to a height of 164.2 in. For casting, a fireclay-lined tundish, 23.6 in. in dia. at the top, was employed. The depth of metal in the tundish was 27.6 in. The diameter of the nozzle was 1.38 in. The casting temperature at the end of teeming, measured by an optical pyrometer, was 1,375 deg. C. uncorrected. The period of casting lasted altogether 40 min., the average pouring rate being 0.835 ton per min. The ingot weighed 33.409 kg.

The compression was commenced 35 min. after the end of teeming. During that period of waiting the mould was cooled by water. The cooling required 1,100 galls. of water. After that the compression was commenced, lasting in all 7 hrs. The maximum final pressure was 8,000 lbs. per sq. in. The total amount of cooling water used was 12,260 galls.

The procedure during the compression is well illustrated by Fig. 3. The diagram shows the way in which the pressure had to be regulated in order that the lower ram should rise in accordance with the given full curve, and the upper ram according to the dashed curve. The curve representing the pressure is shown by a dot-and-dash line. On the diagram the abscissæ represent the time in hours and minutes. The pressure ordinates are given in kg. per sq. cm., and ordinates representing the movements of the lower and upper rams are given in mm. A close study of the curves giving the movements of the lower and upper plungers reveals the differences between the rates of movement of both plungers during the same time intervals. These differences between the rates of movements are due to the formation of the "head" and to the pressing of the steel into the space which would otherwise be the pipe of the ingot.

Fig. 2 gives the position of the original level of the molten steel and the final position of the compressed ingot in the mould; they are shown by full and dashed lines respectively. After being stripped, the ingot was placed in a previously-heated annealing furnace, which was so fired that the temperature of the whole ingot would be uniform at 800 deg. C. Finally the ingot was left in the furnace to cool down slowly.

### Investigation.

The ingot was cut along its longitudinal axis and the middle lines of opposite faces. A sulphur print of the section was then taken. After being reground, the section was etched for primary crystallisation, and finally samples for chemical analysis in the form of drillings and of solid pieces were drilled out. The section showed the ingot to be quite free from pipe.

* A Paper presented at the Autumn Meeting in Prague of the Iron and Steel Institute.

### Primary Crystallisation.

The designation "primary crystal" is given here with a certain reserve, as it is difficult at the present moment to say whether the crystalline structure revealed by etching is actually a primary crystal or whether it was preceded by a δ crystal.

Three aqueous etching solutions were employed:—No. I.—Solution containing 12 per cent. of ammonium persulphate and 4 per cent. of concentrated hydrochloric acid. No. II.—Solution containing 13 per cent. of chromic acid and 5.5 per cent. of concentrated sulphuric acid. No. III.—Solution containing 4 per cent. of concentrated hydrochloric acid. The etching was carried out in the following manner: First, solution No. I was applied for 15 min., then solution No. II for 10 min. After that, etching with No. III for 4 min., and finally again with solution No. II for 7 min., was performed.

This method of etching has the advantage that with it the "dislocated reflection" shows the greatest contrasts, and is limited to the areas of primary crystal grains only. The primary dendritic segregations are not revealed by that method. The etched section is more photogenic than when using other etching agents, as, for instance, ammonium-persulphate solution or nitric and hydrochloric acids.

The boundaries between the columnar and granular crystals are shown in Fig. 4 by dashed lines. By "columnar crystals" are denoted those crystals in which one dimension considerably predominates. The "granular crystals" are those whose sections are more or less equiaxial polygons. In the middle of the bottom near the cooling plate the thickness of the columnar zone is only 3.15 in. It increases towards the lateral faces of the ingot, so that in the outer half of the radius of the base it amounts to 5.90 in. The thickness of the columnar zone at the lateral sides of the ingot is about 7.09 in. This thickness of the columnar zone remains the same half-way up the ingot. In the upper half of the ingot it increases towards the head from 11.8 in. to 14.2 in. At the bottom and the top the orientation of the crystals is perpendicular to the edge. At the walls of the mould the crystals are inclined upwards, forming with them an angle of from 77 deg. to 66 deg. The angle decreases towards the head of the ingot. Some columnar zones have a layer of granular crystals within them. The columnar crystals at the bottom have a sectional area of from 0.028 to 0.039 sq. in.; the columnar grains of the outer layer at the lateral edges have a sectional area of about 0.341 sq. in. In the upper half the crystals of the inner layer along the side are 0.914 sq. in. in sectional area.

The largest columnar crystals are the vertical crystals at the head, their sectional area being on an average 1.705 sq. in. The smallest granular crystals are at the bottom in the layer, in proximity to the layer of columnar crystals; their sectional area is 0.009 sq. in. Another zone of small granular crystals lies along the axis in the second quarter of the ingot height, their sectional area being 0.016 sq. in. The remaining zones of granular crystals are composed of crystals varying in size from 0.093 to 0.341 sq. in. The largest are in the uppermost quarter of the ingot height.

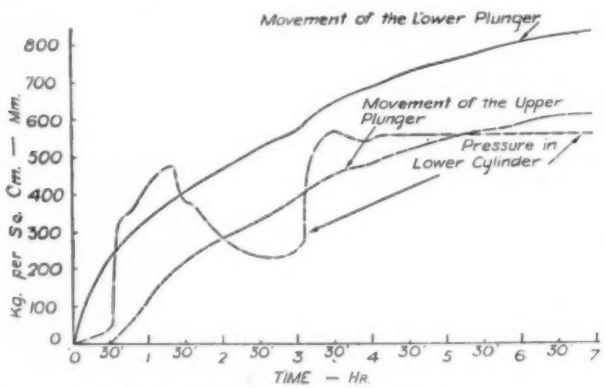


Fig. 3.—Procedure during Compression.

### Sulphur Print.

A sulphur print reveals:—(1) The Λ-segregations occur in the Harmet-pressed ingot only at a greater distance from the ingot wall. It is evident that it is the result of the mould being encircled by iron hoops, and of its being intensively cooled by water. (2) The Λ-segregations reach as far as the axis of the Harmet pressed ingot. The central channel-like segregation seen in the ingots cast in the usual manner is not observed. (3) The Λ-segregations, typical in the central zone of the ingots cast in the usual manner, are not formed. The funnel-like construction of the residual molten steel is here counteracted by the artificial compression. (4) The thick horizontal segregation under the head, evidently due to the compression, is typical. (5) A further typical segregation is in the upper quarter of the ingot. These segregations run parallel to the side wall. This case is evidently not the usual one, but represents a row of isolated segregations partly deformed by compression.

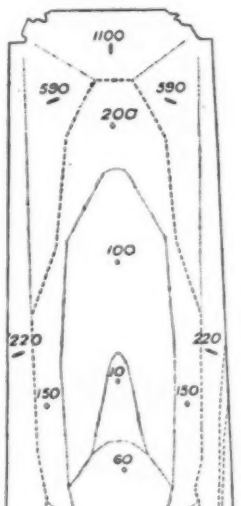


Fig. 4.—Diagrammatic Representation of the Boundaries of the Various Zones of Crystallisation. (The figures indicate the average sizes of the crystals in sq. mm.).

The sulphur print does not only give a picture of the sulphur segregations, but shows in some zones the main axes of large dendrites. The main axes of the dendrites coincide with the main axes of columnar crystals, which is evidently in accordance with the direction of the temperature gradient. In the zone of large granular crystals, however, the main axes of the dendrites have such a varied orientation that no simple connection with the thermal gradient can be supposed.

### Chemical Composition.

The axial section was drilled for samples for chemical analysis. Altogether 89 samples were analysed. The results obtained are summed up in Table I:—

Table I.—*Variations in Chemical Composition.*

| Element. | Average value. Per cent. | Lowest value. Per cent. | Highest value. Per cent. |
|---|---|---|---|
| Carbon .. .. | 0.30 | 0.27 | 0.43 |
| Manganese .. .. | 0.55 | 0.53 | 0.58 |
| Silicon .. .. | 0.17 | 0.16 | 0.20 |
| Phosphorus .. .. | 0.031 | 0.026 | 0.058 |
| Sulphur .. .. | 0.019 | 0.017 | 0.037 |
| Nickel .. .. | 2.07 | 2.03 | 2.09 |
| Chromium .. .. | 0.40 | 0.39 | 0.43 |
| Molybdenum .. | 0.25 | 0.23 | 0.27 |

The average values given in the table have been calculated on the basis of the arithmetical averages of all the values found. Those average values were then taken as a basis for calculating the total percentage differences within which the analytical values of each element varied, the greatest negative and the greatest positive percentage differences being estimated as well. The arithmetical averages were taken as the basis for the percentage calculations instead of the "melt" analyses, because an arithmetical average of 89 samples guarantees better the average values of the analyses.

Table II.—*Difference from Average Values.*

| Element. | Average value. Per cent. | Percentage difference from the average value. | | Total. Per cent. |
|---|---|---|---|---|
| | | Negative Per cent. | Positive. Per cent. | |
| Carbon .. .. | 0.30 | 10 | 33 | 43 |
| Manganese .. | 0.55 | 4 | 5 | 9 |
| Silicon .. .. | 0.17 | 6 | 18 | 24 |
| Phosphorus .. | 0.031 | 16 | 87 | 103 |
| Sulphur .. .. | 0.019 | 10 | 95 | 105 |
| Nickel .. .. | 2.07 | 2 | 1 | 3 |
| Chromium .. | 0.40 | 2.5 | 7.5 | 10 |
| Molybdenum .. | 0.25 | 8 | 8 | 16 |

Differences from the average value expressed as percentages are shown in Table II.

With regard to the distribution of individual elements which show strong segregation, a minimum of phosphorus and sulphur is to be found at the axis of the ingot. The position of these minimum segregations, however, appears nearer the bottom of the ingot than it does in the case of ingots cast in the usual manner. A clear maximum of carbon, phosphorus and sulphur is found at the positions of the characteristic sulphur segregation under the head.

### Silicate Inclusions.

Silicate inclusions were determined by the modified Stead-Dickenson method. In all, 65 determinations were carried out. The arithmetical average was calculated to be 0.021 per cent. The minimum content was determined as 0.013 per cent., and the maximum as 0.047 per cent. Large amounts of silicates were determined at the ingot axis just at one-quarter of the ingot height from the bottom (0.033 per cent.), and also near the head in the top layer (0.039 to 0.047 per cent.).

Some of the residues were analysed. The analysis of such minute quantities is very difficult, and the results should be regarded as approximate. The approximate results are given in Table III:—

Table III.—*Approximate Analyses of Residues.*

| Sample No. | $SiO_2$. Per cent. | FeO. Per cent. | MnO. Per cent. |
|---|---|---|---|
| 6 | 71.8 | 4.5 | 10.4 |
| 12 | 69.7 | 9.1 | 10.2 |
| 15 | 71.0 | 4.4 | 9.8 |
| 25 | 73.4 | 10.1 | 4.9 |
| 46 | 67.7 | 7.4 | 16.5 |
| 17 | 75.6 | 8.0 | 11.9 |
| 88 | 83.7 | 4.6 | 5.4 |

## DISCUSSION.

Dr. W. H. Hatfield (Sheffield) thanked the author on behalf of the Ingot Committee for this valuable contribution to the technology of ingot-making. When the Ingot Committee presented its first report, they would remember that during the discussion it was asked whether the Committee had any information or data showing the effect of pressure applied during the freezing of the ingot. Curiously enough, although practically all the heavy steel manufacturers of Great Britain had, between 1905 and 1908, installed Harmet presses, by the time the first report was issued, there was not one press remaining at work in Great Britain, and he believed the presses at Skoda had been out of operation for some time. They could not, therefore, have the opportunity in Great Britain of studying a large ingot made in this manner, but Dr. Kriz, with the support of the Skoda Company, had stepped into the breach and provided them with a full report of a large ingot, weighing over 30 tons, cast by the Harmet method, and examined in a very perfect manner, a manner absolutely admired by all the members of the Committee.

In one diagram, provided by the author, the author had explained how the ingot was marked out in the various zones of heterogeneity, while in the other diagram they had something far more than that, for they had the actual sulphur print. Let them consider what was the result of this additional contribution to their data. He thought those who raised the question of the effect of pressure applied during solidification really had in mind the following point:—Did great pressure during solidification diminish the heterogeneity of the ingot? To that question he thought they now had the answer. He thought Dr. Kriz would admit that, in spite of the very high pressures applied during the solidification of large ingots, the process of differential freezing was not in any sense modified, and heterogeneity was disclosed, with all its features as found in ingots, where pressure was not applied.

Of course, there was this reservation to make, that the pressure was applied and actually deformed the ingot, in other words, put some work on it, so that there was a certain amount of displacement of the structure. This subject was extremely interesting and important to the major engineering trades. They needed very large ingots for electrical machinery and for high-pressure vessels, *i.e.*, ingots of 50, 100 and 150 tons in weight. It would be interesting if the discussion on this Paper could bring out a good deal of further technical information which they really required. He asked the author what was the size of press used and what was the limitation as regards the size of ingot. Speaking, subject to correction, presumably the limitation of the Skoda press was of the order of an ingot of 40 tons. That simply meant that these high pressures could not be applied to the large ingots in which he (the speaker) was interested.

The Harmet press demanded an ingot with the smaller end at the top and the larger end at the bottom; that did not give the best results. He also wished to ask the author whether his experience at Skoda's had been similar to his (the speaker's) experience years ago when in Britain these large presses were being used; did the pressure result in very high internal stress which frequently led to very serious transverse clinking in the ingot? That was a very serious matter for engineers; he hoped the author would give them some information on that point and tell them how he dealt with it.

One would like to be able to dissociate the effect of the pressure from the effect of the water-cooling, the chilling effect of the mould and the lay-out of the segregation. The author said that compression was commenced 35 minutes after the end of teeming. That meant after about 7-in. walls of solid steel were formed. In Britain, when they had operated these presses they had always put the pressure on as soon as the ingot was cast. Would the author be good enough to explain the motive of postponing the application of the pressure?

Prof. R. Vondracek (Brno, Czecho-Slovakia) said that in this Paper they again found the binary alloys, with the liquidus and solidus lines close to each other, showing no tendency to an increase in the degree of segregation.

As to the dendrites, there was, of course, nothing surprising in the statement that their axes coincided with the axes of columnar crystals, because the dendrites formed the internal structure of the crystals. Since granular crystals had no preferential orientation, the axes of their dendrites must also be arranged at random. Nevertheless, it might be interesting to know whether there were any changes in the orientation of the dendrites due to the wire-drawing of steel during solidification. The development of the dendritic structure on the same test-pieces might be of some value.

Prof. Bradley Stoughton (U.S.A.) said that in America during the past few years this practice had been given up altogether, and the presses had not been used. He thought the last press in the United States, which happened to be a Harmet press, was actually dismantled a year or two ago. This Paper he was sure would convince them that they had made a mistake in abandoning this method of improving the quality of steel.

Mr. C. H. Ridsdale (Middlesbrough) said he had a few figures which might contribute something to this important Paper. As he had only read it a few days before, he had had to collect his data hurriedly. In 1925 he had wanted to get a bloom of undoubted homogeneity because it was wanted for analytical-standards purposes. He had got this bloom from a Harmet-pressed ingot. The composition was as follows:—Carbon 0.153, manganese 0.527, silicon 0.176, phosphorus 0.036, sulphur 0.050, nickel 0.026, chromium 0.040 per cent. He had now given similar data to that supplied in Table II of the Paper; but his (the author's) bloom had also contained arsenic 0.03 and copper 0.04 per cent. Of course, that was not as much of an alloy steel as the ingot described in the Paper. His (the author's) example was not an ingot, but it did represent the whole cross-section of an ingot, because it was a bloom simply rolled or forged down. The bloom had been cut into various pieces, slices sulphur-printed at each end and analyses made at six depths from the outside to the core. The variations in the steel itself, as tested by one chemist, were something like half the variations as between 10 chemists, showing that the variations of the steel were lower than the experimental error of the chemist.

Dr. A. M'Cance (Glasgow) said he wished to congratulate Dr. Kriz on his wonderful sulphur prints; they indicated a skill in the technique of sulphur prints which was quite extraordinary. With regard to the actual results obtained as shown in the Paper, he thought the most noticeable thing was the absence of the "A" segregate down in the centre. That was probably the main result of the Harmet process. He wished to ask Dr. Kriz if that result was worth the other disadvantages which appeared to be inherent; the fact that the ingot was tapered the wrong way, as mentioned by Dr. Hatfield, that there was an absence of sinking test which tended to minimise the segregation in the body of the ingot as apart from the head; was Dr. Kriz, after such a complete and interesting investigation, in a position to dissipate the doubt which arose in his (the speaker's) mind as to whether those disadvantages outweighed the advantages of the Harmet process?

One other technical point which arose in connection with this crystal grain was that he noticed from the author's diagram that down the centre of the ingot there was an area which had smaller crystal grain areas than any other portion of the ingot; he would be indebted to Dr. Kriz if he could offer any explanation of what appeared to be a rather extraordinary fact.

Mr. G. Wesley Austin (Greenock) said Dr. Kriz had taken three notable steps in this work. He had first of all given them a section of an ingot on which he had marked the grain size; he remembered no Paper in which that had been done before. Secondly, in his analytical result he had taken an arithmetical average of a very large number; that was also a definite advance, and great accuracy should result from it. Thirdly, he desired to ask Dr. Kriz if he thought that the analyses he showed were approximately those of the deoxidation products of acid steel.

The President said that Dr. Kriz preferred to reply in writing.

## Iron and Steel Industry in British India.

The Indian iron and steel industry is suffering from the depression which is affecting practically every country in the world. The Tata Iron & Steel Company, the largest iron and steel undertaking in India, has been feeling the effects of the depression. Not only have orders from the general public fallen off, but also those from the Government. The company has been endeavouring to face the situation in the hope of better times and so far has carried on as usual. The company's stocks, however, are increasing daily, due to the fact that it cannot sell the products it is now making. By September 1 the entire rail orders for this year were to be completed, which means that any rails rolled between September 1 and April next will have to be put into stock. Likewise, the merchant mill is now rolling for stock. Last August the company received orders for 3,000 tons of steel only, whereas it is producing at the rate of 8,500 tons. The stocks at the present time in the plant and in the stockyards up-country are about 45,000 tons, and this quantity was expected to be increased by another 10,000 tons by September 1.

Rather than shut down the rail and merchant mills entirely the management propose, to commence with, to work the new blooming mill, the rail mill and the sheet-bar and billet mill on one shift only. The company will review the situation at about the end of this month, and if the merchant mill situation does not improve, it may be necessary to shut down one shift on that mill on October 1. About the end of October the company will again review the situation, and if things are not better, may shut down some of the trains in the sheet mill.

The annual report of the Tata Iron & Steel Company, which was recast following the decision not to pay a dividend on the second preference shares, shows net profits for the year ended March last of Rs. 82,25,000. The directors recommend the appropriation of Rs. 74,50,000 to the depreciation account and the payment of two years' dividend on the first preference shares, which will absorb Rs. 8,00,000.

## Contracts Open.

**Glasgow,** October 15.—Twin-screw steam hopper barge, for the trustees of the Clyde Navigation. Mr. D. Fife, mechanical engineer, 16, Robertson Street, Glasgow. (Fee £2 2s., returnable.)

**London, S.E.,** October 7 and October 31.—20 locomotive engines and tenders and 3,000 tons of steelwork, for the India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 5s., non-returnable.)

**London, S.W.,** September 30.—1,294 tons of steel material, for the Madras and Southern Mahratta Railway Company, Limited, 25, Buckingham Palace Road, Westminster, S.W.1. (Fee £1 1s., non-returnable.)

**London, W.,** October 3 to 24.—Iron and steel stores, for the Great Western Railway. The Stores Superintendent, Swindon.

Respecting the supply of electricity to Maryport, it was stated at a meeting of Maryport Council that arrangements for carrying out the works would be proceeded with immediately the Mid-Cumberland Electricity Special Order passed through Parliament.

# Application of Brass Ingot Metal in Industry.*

By W. Romanoff and C. O. Thieme.

The ingot-brass industry has made rapid strides during the past ten years in the development of processes and improvement of the quality and uniformity of the product. This, to a large degree, has overcome the "conscientious objection" to the use of its products.

The smelter and refiner began to realise that, to survive, they must consistently make a product which would satisfactorily compete with virgin metals. Years ago ingot manufacturers did not enjoy a healthy reputation, but the authors believe this was due to metallurgical ignorance of those in the ingot business rather than to any malicious attempt to misrepresent their product or to make ingots not uniform or properly refined.

Through all this it was realised also that, in order to make a good product, technical control must be established. Imaginative secretiveness is disappearing rapidly among the brass-ingot manufacturers, and now, after years of diligent effort and research, tremendous improvement is noted.

### Application.

It is a known fact that the most vital factor in the manufacture of good castings is that of foundry practice. Improper gating of castings can cause a shrinkage condition, dirty castings, mis-runs, etc. The wrong pouring temperature will cause the castings either to mis-run or to be porous throughout, as well as rough on the surface. Shifted castings are usually due to defective pattern equipment. Poor sand conditions will create surface porosity or roughness and other defects.

After foundry practice, the question of metal arises, and under this heading the application of brass ingot metal. By ingot is meant a cake or block of alloyed brass or bronze that has been obtained from the refinement of secondary metals as a base. This refinement, in general, is as follows:—

Secondary metals are sorted into various classifications and then melted in large quantities, usually in the open-hearth type of furnace, although other types of furnaces find application with some types of alloys. After melting, air is introduced, which either eliminates the easily oxidisable impurities—such as silicon, manganese, aluminium, phosphorus, iron, etc.—or reduces them to percentages not objectionable nor detrimental.

After these impurities are slagged off the top of the bath, the molten metal is then poled with green saplings to reduce the oxides of the main constituents formed by the introduction of air. During this entire process, chemical analyses are made and test plugs are examined. The metal is then built up to specification and poured into ingot.

The authors have found from experience, observation and test that any brass and bronze castings which have been or are being made from virgin metals can be made from ingot without detrimental lessening of the physical properties. Of course, certain castings call for chemical specifications which are not within the range of ingot manufacture, but most of these chemical specifications are more traditional than essential.

In the past, too much stress has been placed upon chemical characteristics of metal when it really was subservient to foundry practice in obtaining the desired physical properties. Time and time again the authors have obtained a variation of as high as 4.5 tons per sq. in. in tensile strength from the same pot of metal, merely by varying the pouring temperature; and there certainly was no change in the chemical analysis of the various test-bars poured.

* A Paper read at the Cleveland Convention of the American Foundrymen's Association.

In line with this, a special committee of the American Society for Testing Materials, working in conjunction with the Non-Ferrous Ingot Metal Institute, has found that there are about 600 different specifications for brass and bronze ingots, which no doubt can be reduced to about 30 or less. Supposedly, at various times, castings have been analysed and these analyses set up as specification without rhyme or reason.

### Ingot *versus* Virgin Metal.

Without question, copper is the most delicate of the metals used in the manufacture of brass and bronze, due to its tendency to absorb gases readily—both oxidising and reducing gases. Foundrymen know that as the copper content of castings increases, the difficulty with non-metallic impurities also increases. They seldom have trouble with low-copper-content castings in so far as non-metallic impurities are concerned. Most of the grief in the much-abused manganese bronzes is due to improper gating and pouring temperatures and not to non-metallic impurities.

In melting virgin metals, the copper is melted first and the tin, lead and zinc added later. The copper may be thoroughly oxidised before the latter is added. This is partially avoided by the use of ingots as the copper, tin, lead and zinc are thoroughly alloyed or mixed before placing the charge into the furnace. As the latter are natural deoxidisers for copper, there is thus greater opportunity for obtaining sound castings when ingots are used. Again, in the use of virgin metal, the copper, tin, lead and zinc must be weighed separately. This may work havoc if chemical analysis, uniformity of product and maximum physical properties are desired; if a mistake is made in weighing, the chemical analysis is "thrown off," and often the change in properties of the alloy seriously affects machine-shop operation. This is not true when ingots are used, for if a mistake is made in weighing, there is simply more or less metal without affecting the analysis in the least.

It is not wished to convey the impression that virgin metal cannot be used successfully. It is merely wished to point out the fact that ingot is more "foolproof."

In Table I it will be noted that practically the same physical properties were obtained from test-bars poured from ingot and from virgin metal where they were both melted and poured under the same conditions. Standard 85-5-5-5 was used.

Table I.—*Physical Properties of Virgin and Ingot Metal Melted and Poured under Same Conditions.*

| | T.S. Tons per sq. in. | Elong. Per cent. | Brinell. | P.T. Deg. C. |
|---|---|---|---|---|
| Virgin alloy | 14.86 | 23.0 | 57.5 | 1,150 |
| Ingot alloy* | 14.39 | 21.0 | 57.5 | 1,135 |

* Average of 28 heats.

In passing, one must not overlook the fact that, granting all things being equal in so far as physical properties and good castings are concerned, considerable saving can be made by using ingot instead of virgin metals of the same composition. In these highly competitive days this may determine the difference between a profit and a loss for some foundries.

### Has "Life" been "Burnt" Out of Ingot Metal?

One is often confronted with the argument that the secondary metal from which ingot is made has been remelted so many times that the "life" has been "burnt" out. "Burnt" metal is really a misnomer. What is really meant is oxidised metal.

Some of the constituents, particularly zinc and lead, may be oxidised or volatilised, but brass is not burnt as is steel. In the latter it happens in the solid state when, during a heat-treating operation, the temperature is brought up to such a point that gases get into the steel and separate the crystals. When such a condition is found in brass, it is more often due to furnace atmospheres and excessive pouring temperatures.

The results given in Table II prove that, for practical consideration, the number of times metal is remelted does not affect the physical properties if carried out under the proper conditions and if the chemical composition is maintained.

Standard 80-10-10 and 85-5-5-5 ingot were remelted ten times; each time some test-bars were poured, and the balance of the metal was poured into ingots and remelted. Zinc, tin and lead were replaced as found necessary. It will be noted that the physical properties are practically the same.

Table II.—*Effect of Remelting on Physical Properties of Ingot Metals.*

| | 80-10-10 | | | 85-5-5-5 | |
|---|---|---|---|---|---|
| | T.S. Lbs. per sq. in. | Elong. Per cent. | | T.S. Lbs. per sq. in. | Elong. Per cent. |
| 1 .. | 29,600 | 9.0 | 1 .. | 31,050 | 23.0 |
| 2 .. | 29,850 | 9.0 | 2 .. | 31,500 | 21.0 |
| 3 .. | 29,950 | 10.0 | 3 .. | 32,000 | 20.0 |
| 4 .. | 28,500 | 10.0 | 4 .. | 33,000 | 19.0 |
| 5 .. | 29,200 | 11.0 | 5 .. | 32,200 | 22.0 |
| 6 .. | 29,950 | 9.0 | 6 .. | 31,700 | 20.0 |
| 7 .. | 30,600 | 10.0 | 7 .. | 32,000 | 20.5 |
| 8 .. | 29,950 | 10.0 | 8 .. | 32,600 | 19.0 |
| 9 .. | 30,500 | 10.0 | 9 .. | 33,400 | 21.0 |
| 10 .. | 31,500 | 9.0 | 10 .. | 32,100 | 22.0 |
| Usual specification | 28,000 | 8.0 | | | |

### Conclusion.

The authors do not feel that in this short discussion they have covered all the details regarding the application of ingot to industry. They believe, however, that they have shown that just as good results can be obtained from ingot as from virgin metal, and that it is more "foolproof" in its use, in addition to effecting a saving in money.

They have also proved that metal can be remelted any number of times without deleterious results. This fact should eliminate the old shibboleth that ingots are inferior because they are made from secondary metal which may have been remelted many times. The pendulum is swinging the opposite way. To-day, foundrymen who still use virgin metal either are remelting it into ingot before using, or are purchasing an ingot made from virgin metal.

In closing, it might again be repeated that trouble can occur in a foundry regardless of what metal is being used, but that, with proper foundry practice, there will be less trouble with ingot. Any foundry can thus avail itself of the benefits derived from the chemical control and metallurgical knowledge and experience put into its product by the large reputable ingot manufacturers, if it does not have this technical control itself.

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**Steel Structure Research.**—A conference on steel structure research will be held in the Lecture Theatre of the Institution of Civil Engineers at 11 a.m. on October 16, 1930. The purpose of the conference is to promote discussion of the work and objects of the Steel Structure Research Committee of the Department of Scientific and Industrial Research. This Committee has been set up to review existing regulations for the use of structural steel in buildings and bridges, and to investigate the possibilities of more efficient and economical design. The conference will provide an opportunity for an exchange of views and for a consideration of various suggestions that have been made, in particular the feasibility of formulating a standard practice in the use of structural steel in building throughout the United Kingdom. Any bodies who may wish to be represented at the conference are requested to communicate with the Secretary, Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1.

# Core-Room Conveyors.*

By D. B. Hill.

The economical transportation of cores has been a source of great expense and the subject of much study. An early type of core oven was a large box or room heated to a baking temperature. The cores were placed in racks and were transported to and from the ovens by means of lift trucks. The objections to this method included the breakage of cores, the investment for trucks and truck maintenance, and the large number of racks and the amount of floor space and labour required. One of the first-noted improvements upon this method was the substitution of I-beam monorail and trolleys for lift trucks. The core racks, suspended from trolleys, were transported to and from the ovens and the monorail served as a storage and cooling space.

The advent of mass production in all branches of industry—especially noticeable in the manufacture of motor-cars—made large-production foundries necessary. Soon engineers were faced

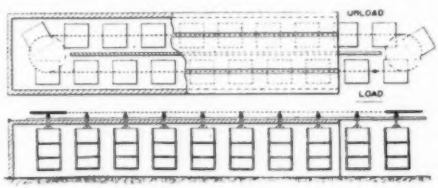



FIG. 1.—AN EARLY TYPE OF POWER-DRIVEN CONTINUOUS CORE-OVEN CONVEYOR.

with the problem of increased core-room capacity. The continuous movement of cores through the operations of making, baking, cooling, pasting and delivery to moulders was suggested by progressive foundry and conveyor engineers. This method would be in keeping with the continuous transportation of moulds already adopted. The wisdom of using conveyors for this purpose was questioned by many. It was thought that vibration would break the green cores before they could be baked. The investment for continuous core ovens and conveyors seemed to be out of proportion to the work accomplished. The protection of the conveyor chain and mechanism from the oven heat presented a difficult problem.

The earliest type of power-driven continuous core-oven conveyor, shown in Fig. 1, was successful enough to justify the idea that cores could be baked by a continuous process. This type of oven was of brick and employed two sprockets with a conveyor chain placed above the oven. Slots through the roof of the oven permitted the suspension member connecting the trolley to the core rack to follow the travel of the chain.

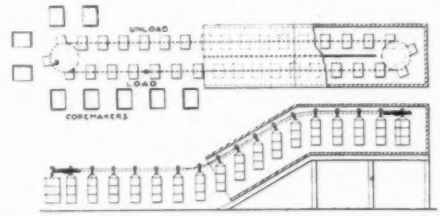



FIG. 2.—A HORIZONTAL-TYPE CORE OVEN INCORPORATING IMPROVEMENTS UPON THE DESIGN SHOWN IN FIG. 1.

Objections found in this design were:—(1) Enormous heat loss due to slots in the roof of the oven and the lack of heat seals at the entrance and exit; (2) oven occupied useful floor space; (3) loading and unloading spaces limited; (4) insufficient cooling time, and (5) transporting green cores due to inability to group core makers adjacent to loading point.

The design which was offered to overcome some of these objections is shown in Fig. 2.

### Horizontal Ovens.

The first oven of the horizontal type occupied a comparatively small floor space, due to the type of cores produced. It was designed for cores requiring a short baking time. By making the length of the conveyor outside of the oven of sufficient length to include cooling period and unloading space, together with the space around which the core makers were grouped, the objections found in the oven shown in Fig. 1 were overcome. The inclination of the entrance and exit of the oven formed the heat seals. This construction required the use of sheet-metal ovens instead of brick. Placing the conveyor in the oven eliminated the slots in the roof and reduced heat losses to a minimum.

In order to meet the conditions imposed by this design, the conveyor engineers were confronted with the designing of a chain which would operate in both the horizontal and vertical planes. This resulted in the type of chain and trolley shown in Fig. 3. The 6-in. diameter

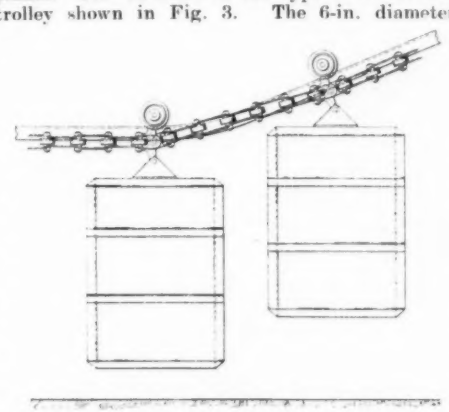


FIG. 3.—CHAIN AND TROLLEY UNIT NECESSITATED BY THE OVEN DESIGN OF FIG. 2.

wheels of the trolley operate over double-angle tracks and are fitted with anti-friction bearings. The trolley stem is suspended from a high-carbon steel shaft and supports the core rack in such a position that the shelves always remain in a horizontal plane. A transverse joint provided at the junction of the chain and trolley stem permits the chain to travel up and down inclines as well as on horizontal tracks.

The rollers in the chain joints provide for operation around roller-turn and traction wheels, and make action on the drive-sprocket easier. Trolleys equipped with anti-friction bearings can convey loads of a ton per rack with little power.

The largest oven of the horizontal type of which the author has a record has 150 racks, with a gross load of one ton each, and requires a 5-h.p. motor to drive the conveyor. An example of an oven of the larger type is shown in Fig. 4. This oven is designed to serve bench core makers. A conveyor passes between the two rows of benches. The core makers face the approaching conveyor and rack, permitting the makers to select a location to place their cores. A half-turn of the body and a step is the only movement required to load the rack.

The conveyor track is inclined so that the lower shelves of the rack are loaded as easily as the upper. With this load the rack travels up an inclined track of 20 deg. into the oven proper, traversing its length three times on level track fitted with expansion joints. The chain leaves the oven over an incline, converging into a horizontal track before reaching the drive sprocket. The contraction and expansion of the chain is compensated by the movement of the counterweighted take-up carriage. This mechanism is located adjacent to the drive sprocket. From the take-up the conveyor passes around a roller turn to a portion of straight track where the racks are unloaded on to filing, sorting and fitting benches. From this point the empty racks pass underneath the oven to the original starting point. Sprocket and traction wheels are all mounted on anti-friction bearings.

### Meeting Present-Day Requirements.

In order for a continuous-conveyor oven to be successful, the following conditions must be met:—(1) Adequate and accessible loading space, (2) ample baking time, (3) sufficient time and apparatus for cooling, (4) well-located unloading position and (5) produce cores economically. An oven which illustrates all of these features is shown in Fig. 5.

This conveyor makes four passes through the length of the oven. As the conveyor leaves the

FIG. 4.—LAY-OUT OF LARGE-TYPE HORIZONTAL OVEN, DESIGNED TO SERVE CORE-MAKERS' BENCHES.

oven it passes through an enclosed cooling chamber, which completely surrounds the drive and take-up mechanism, and is supplied with the necessary fans for directing a blast of air on the cores. The cores are cooled to a temperature so that they can be unloaded with the bare hands. Cores, together with their plates, are placed on to a gravity conveyor underneath and extending the length of the oven. Cores are unloaded, classified and stored on racks or transported to the foundry. The plates are returned to the makers' benches from the gravity conveyor. The makers' benches are located adjacent to the oven.

A belt conveyor is situated directly behind the makers and transports the cores through a distance of approximately 100 ft. parallel to the oven. Cores are removed from the belt conveyor, dipped into a blackening tank and loaded on to the conveyor racks at a point prior to

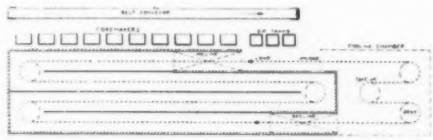


FIG. 5.—MODERN CONTINUOUS-CONVEYOR OVEN, DESIGNED TO MEET PRESENT-DAY REQUIREMENTS.

entering the oven. This unit was designed to bake 480 crank-case cores per hr.

### Advantages of the Horizontal-Type Continuous-Conveyor Core Oven.

*Saving in Floor Space.*—It is shown that the space underneath the oven may be used for core or rack storage, sorting, filing, fitting, blacking, pasting or inspecting cores, etc. The ovens in many cases are supported above roof trusses, keeping the floor clear of supporting columns. Installations have been made where the oven extends over an areaway between buildings.

*Labour Saving.*—With the conveyor located adjacent to core-makers' benches, the time spent

* A Paper read before the Cleveland Convention of the American Foundrymen's Association.

in walking to and from distant racks is eliminated. The labour used in transporting racks from the makers to the oven is entirely dispensed with. In the process of loading rack-type ovens it is often necessary to move the rack several times before it is placed in the oven. One large automobile firm had a piece rate of 1¾ cents for each movement of racks. This item alone amounted to thousands of dollars per year.

*Reduced Core Breakage.*—Handling cores on racks with trucks resulted in a large loss due to rough floors, collision with other objects, etc. With the smooth operation of the oven conveyor, this breakage is negligible.

*Pace Setter.*—As the racks travel in full view of the operator, this enables him to time his movements with the speed of the conveyor.

*Uniformity of Product.*—With each rack load of cores receiving the same baking and cooling time, the product will become uniform. This eliminates the human element which enters into the loading and unloading of rack-type ovens.

*Working Conditions.*—Heat is confined in the sheet-metal oven with insulated walls and heat seals. With this construction a comfortable temperature can be maintained in the core room. This condition could not be enjoyed where rack-type oven doors are opened for loading and unloading.

*Reduction of Equipment.*—With the conveyor returning racks, core plates and dryers at regular intervals, the amount of this equipment is materially reduced. The increased production

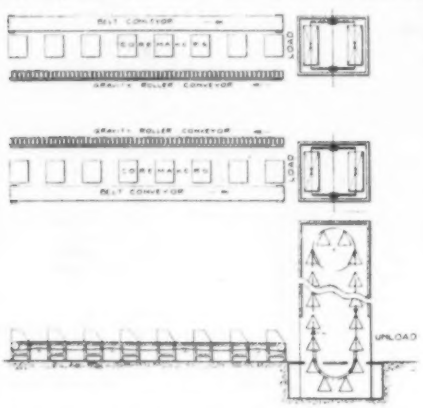



Fig. 6.—Two Ovens intended for Large Production.

per man decreases the number of core machines required.

### Vertical Ovens.

Due to architectural limitations of present core rooms, nature of the product and other limitations, the vertical-type oven has met with the approval of a large number of plant owners and operators. The vertical oven is used advantageously for baking small cores and drying cores after blacking and after pasting. The limitations of the vertical oven for baking cores are based on the requirements noted under the heading "Meeting Present-Day Requirements."

If the production is very large, it is often difficult to place the core makers in accessible position for loading directly on to the core racks. To overcome this the core makers are grouped parallel to a belt conveyor, which serves to deliver the cores from the makers to the oven. The belt conveyor is usually constructed as a gravity carrier, with idler rolls on the carrying side to prevent undue sagging and resultant vibration in the belt. As the cores reach the oven, an operator is required to unload the belt and place the cores on to the racks. The cores are usually unloaded on the opposite side, the plates remaining on the racks, and are unloaded by the loading operator. These plates are distributed to the core makers by a section of gravity extending the length of the bench layout. A view of two ovens utilised in this manner is shown in Fig. 6.

An unusual take-up mechanism is used in this design. It consists of a frame in the form of a "U" fitted with counterweights, if necessary, and eliminates the necessity of shaft and sprockets at this point. It meets the requirements of the expansion and contraction of the chain and also provides for loading between the vertical strands of the conveyor. The space between the vertical runs of the conveyor can be floored over, giving easy accessibility to the core makers.

The vertical oven is recommended for baking small cores only, because it is practically impossible to extend a vertical oven of this type sufficiently high to incorporate the required amount of cooling time and apparatus for large cores.

A very unique design employing the vertical oven, together with a conveyor, and which serves the core makers, provides ample cooling time, unloading space and return of plates and dryers to the operators, is shown in Fig. 7. The operators on this installation are all girls. They are placed on a mezzanine floor and segregated from the male employees. The core room is fully enclosed. Proper lighting and ventilation is provided, making the department ideal for this type of work.

The benches are located adjacent to the upper run of the conveyor. The conveyor is inclined so that the top and bottom shelves are loaded without undue exertion on the part of the operators. The conveyor passes through the vertical runs of the oven. On the descending side, the cooling fans are placed so that the cores are sufficiently cooled to be unloaded with the bare hands. Cores are sorted into tote-boxes placed on gravity conveyors. These conveyors may be placed in suitable locations on either side of the lower horizontal run of the oven conveyor. The plates and dryers are placed on racks and are returned through the floor to the operators on the mezzanine floor.

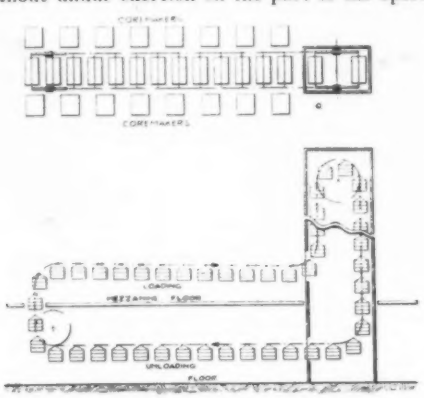



Fig. 7.—Novel Design of Vertical Oven, providing Ample Cooling Time for either Large or Small Cores.

This type of installation provides for every requirement necessary for the successful operation of a continuous-type conveyor oven. The conveyor used in this and other vertical installations consists of two parallel strands of steel-bar bushed-roller chain. The rollers are unusually large in diameter, fitted with bronze bushings and provided with a large oil reservoir eliminating the possibility of the conveyor operating without lubrication. The parallel strands of chain are connected by means of cross-rods over which extra-heavy pipe is placed. The pipe provides for additional stiffness, and, due to the fact that it is easily replaced in case of wear, it has proven an added feature in this design.

The racks are suspended from these cross-rods by U-bolts, which provide for easy installation and removal. The absence of sprockets on the mezzanine floor is an additional safety feature which has been evolved in this design. It may be employed with excellent results for large cores as well as small ones. This is due to the fact that a cooling chamber can be included in the horizontal run up to the point of unloading.

Pasting, drying and blacking ovens usually are very small, due to the speed of the conveyor. Twenty to thirty minutes cover the usual time required for these operations. These units are usually of such a height that they may be moved from one location to another in the foundry, as the occasion demands. This advantage has been valuable in several instances of rapid expansion in different plants.

### Other Types of Conveyors.

This Paper would not be complete without mentioning other types in addition to the core-oven conveyor. Gravity carriers, properly designed belt conveyors and other types may be used to advantage. The overhead-monorail system of distributing sand to core makers has met with the general approval of everyone concerned. Usually one operator with an electrically-operated machine can distribute the sand required for 50 to 60 core makers. This equipment is usually supported from the roof trusses, leaving the floor free of any additional supporting columns.

## Canadian Steel Developments.

The increases in steel duties contained in the Canadian Budget have already brought about several outstanding developments. The Algoma Steel Corporation, which recently undertook the remodelling of its heavy-steel-rail mill and structural-steel plant, is making good progress in the construction work involved. This month the Canadian Steel Corporation, Limited, the subsidiary in the Dominion of the United States Steel Corporation, is likely to complete its new tinplate mill. At the Ojibway (Ontario) plant of the company, near Detroit, Mich., tinplate mills with a combined capacity of 60,000 tons per annum are being erected. A part of the plant making galvanised sheets is already in operation, its capacity being 34,000 tons a year.

It is not economical to make heavy steel plates or structural sections in Canada with the existing restricted home market. The manufacture of plates, however, is being extended to heavier sizes as occasion warrants. For instance, Dominion Foundries & Steel, Limited, of Hamilton, Ont., have announced their intention to add $300,000 worth of equipment to their steel-plate mill for the purpose of diversifying their products and presumably producing certain sizes of plate now imported.

The Steel Company of Canada, Limited, has just placed in operation its new wire-galvanising plant at the Hamilton plant. A machine having a rated capacity of 50 tons of 54-in. plate daily is in use at Hamilton, while a second machine of similar capacity is almost ready. A smaller machine is also nearing completion, and will operate within a short time. The plating machines of the company now have a capacity of 34,000 tons a year. The galvanising plant constitutes a part of the general scheme of improvements undertaken by the Steel Company of Canada several months ago. In addition to this work, the programme covered two open-hearth furnaces, a 10-in. and 12-in. merchant mill, a cleaning plant for blast-furnace gas, a central pumping station, a new ore dock and various minor improvements at other plants outside of the Hamilton area.

## Iron and Steel Output in August.

The National Federation of Iron and Steel Manufacturers report that the number of furnaces in blast at the end of August was 104, a net decrease of one since the beginning of the month. The production of pig-iron in August amounted to 416,700 tons compared with 486,100 last July and 682,000 tons in August, 1929. The production included 113,900 tons of hematite, 158,900 tons of basic, 101,200 tons of foundry and 30,200 tons of forge pig-iron. The August output of steel ingots and castings amounted to 451,300 tons compared with 621,400 last July and 753,300 tons in August, 1929.

# A Model Brass Foundry.

The brass foundry of a large firm of engine makers who produce great numbers of every type of power unit, from small petrol-paraffin sets to the largest heavy-oil and gas engines, is naturally an important link in the production chain. Our two illustrations show the new brass foundry of the National Gas Engine Company, Limited, Ashton-under-Lyne. It has been laid out in the most efficient manner, so that the minimum of handling of the material shall take place. At the same time, however, it has been recognised that efficient production is also largely dependent on the health and comfort of the workmen, and everything has been done conducive to this end. The Home Office, after inspection of the foundry, considered the arrangements so effective that they asked to be supplied with photographs of the building.

In Fig. 1 casting operations can be seen in progress; the molten metal from the 120-lb. ladle can be easily man-handled. A 2-ton pulley block is, however, provided on a run-way for occasional heavy castings.

The fettling shop consists of a tumbler barrel, a small Tilghman's sand-blast plant, a git-saw and a pair of grinding wheels with dust extraction coupled up to the ventilation system. The ventilation arrangement was carried out by Messrs. Hall & Kay, Limited, ventilating engineers, of Ashton-under-Lyne.

The building in which the new foundry has been laid out was an existing one which has been modified for its current purpose, and the National Gas Engine Company now has in it a foundry of ample size for its requirements of brass and similar castings.

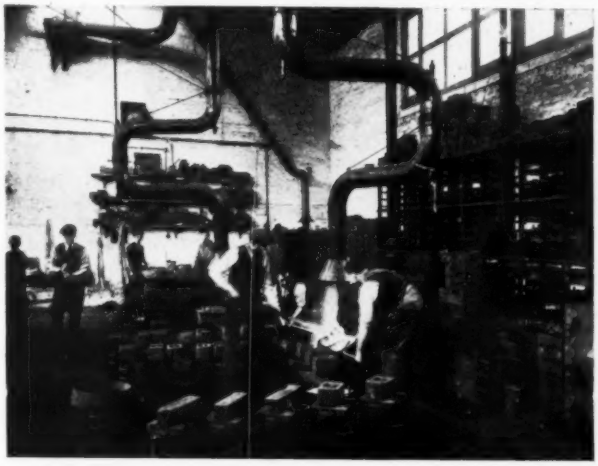


FIG. 1.—CASTING OPERATIONS IN THE BRASS FOUNDRY OF THE NATIONAL GAS ENGINE COMPANY, LIMITED, ASHTON-UNDER-LYNE.

FIG. 2.—ANOTHER VIEW OF THE FOUNDRY, SHOWING THE VENTILATION TUBES.

held by the two workmen is being poured into a mould, whilst all the fumes are being carried away clear of the workmen up the bell-mouthed ventilation pipe immediately above the ladle. The necessary draft is provided by the electrically-driven fan, which can be seen in the top left-hand corner. Fig. 2 shows the other end of the foundry, where similar operations are taking place. Here, again, the fumes from the metal are being carried away. The construction of the ventilation pipes, it should be noted, enables the mouth of the pipe to be brought in position over any part of the moulding floor.

The two M.R.V. furnaces in which the metal is melted are shown in Fig. 2 at the far end of the foundry. The furnaces are of the tilting variety, each containing a crucible capable of holding 440 lbs. of metal. The crucible life is approximately 100 heats each. Special arrangements for dealing with the fumes from the furnaces have been installed, but these are not visible in the illustrations. The temperature of the metal furnaces is controlled by thermo-couple pyrometers. Practically all the castings are either plate-moulded or machine-moulded, and they are all thoroughly cleansed by rattler or sand-blast before leaving the foundry. Cores are dried in a gas-fired stove.

This foundry has a total length of 92 ft. 6 in. and a width of 25 ft. The height to the eaves is 18 ft. and to the ridge 25 ft. Half the windows on each side of the shop can be opened and are hinged on a central vertical axis. Air grids 18 in. × 9 in. are arranged just above floor level at each side of the building. The majority of the castings made are of a size that

## Catalogues Received.

**Alloy and Tool Steels.**—Messrs. John Brown & Company, Limited, Atlas Works, Sheffield, in the third edition of their catalogue carrying the above caption, set out the manufactures by listing and describing their products. In these descriptions, there is, necessarily, an overwhelming amount of printed service, as in every case a full and complete description is given of how to prepare each steel in order to obtain the best properties for any given purpose. The interest for founders is maintained in the earlier portions in page after page, as the uses to which the various steels are to be put usually include hard cast iron or cylinders or pneumatic tools. Naturally, when it comes to magnet, alloy and case-hardening steels the interest is mainly for the engineering side. Steels conforming to B.E.S.A. specifications are set out in pages 80 to 85, and that vicinity, and immediately one notices that, being finished entities, the buyer is expected to know how to handle them. Steels other than structural, to our mind, are unsuitable material for standardisation, as its very nature tends to make the manufacturers rest on their oars. However, very little has been done beyond a few plain carbon steels, nickel case-hardening and an odd nickel chrome or two. The last few pages carry a few conversion tables germane to the steel industry.

We have only one adverse criticism to make, that is no preface or introduction has been included, but, on the other hand, we are full of admiration for the general get-up, the illustrations, the indexing and the technical data. Whilst no offer of general distribution to our readers has been made, as, obviously, this is an expensive publication, we feel sure that responsible members of the foundry industry will receive a copy on request.

**Foundry Moulding Equipment.**—A four-page leaflet received from the Coleman Foundry Equipment Company, Limited, of 14, Southampton Street, Strand, London, W.C.2, illustrates three types of moulding machines, a line of Berkshire vibrators, hose connections, blow cock and a knee valve. The vibrators range in size from ½ to 2 in. and in weight from 1 lb. 3 ozs. to 26 lbs. A useful table of air consumption is also given.

**Steel Sleepers.**—From a 12-page catalogue, issued by the Workington Iron & Steel Company Branch of the United Steel Companies, Limited, Workington, Cumberland, we note that a number of designs are now available for steel sleepers, but they have all one thing in common, there is a complete elimination of the cast-iron chair. Whilst congratulating Workington on their enterprise and excellence of their publicity matter, we just wonder whether some of the newer high-strength cast-iron castings could not be made to serve the purpose more cheaply. It seems a big jump from wood to steel, but we suppose the reputation for lack of elasticity has damned cast iron. However, it is cheering news to learn that to make a ton of steel sleepers the railways have to convey about 5 tons of coke, ore, limestone, etc., and as the locomotive, carriage and wagon departments of the railways are still good customers of the foundry, that industry will reap some slight benefit from the new departure.

XUM

## Trade Talk.

Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend-on-Tyne, have obtained an order for two large motor tankers for Norwegian owners.

A meeting of creditors of Messrs. C. & J. Anderson, ironfounders, of Blairland Foundry, Dalry, Ayrshire, is to be held to-morrow in the offices of Messrs. Dunlop & Murray, C.A., Glasgow.

Messrs. Henry Simon, Limited, have transferred their offices from Mount Street, Manchester, to their works at Cheadle Heath. The company's telegraphic address remains unchanged.

The Rushton Tractor Company (1929), Limited, has secured a large contract for farm tractors for Algeria, where American tractors have hitherto almost exclusively been used.

As a result of their activities in connection with the Liége International Exhibition, the Belgian Foundry Employers' Federation has been awarded a gold medal by the Belgian Government.

Messrs. D. & W. Henderson & Company, Limited, Partick, have secured an order from the Southern Railway for a twin-screw steamer for a motor-car ferry service between Dover and Calais.

Messrs. David Caird, Limited, Barrow, are making extensive additions to their Furness Foundry & Engineering Works. Messrs. Caird are associated with the Charcoal Iron Company, Limited, of Backbarrow.

Messrs. C. A. Parsons & Company, Limited, Newcastle-upon-Tyne, are reported to have received the contract for the electrical generating plant required for the large grain elevator now being constructed at Fort Churchill, Hudson Bay, Canada.

The first section—4½ miles long—of the new £4,000,000 underground railway in Buenos Aires is approaching completion, and is to be opened for traffic in the early autumn. Cars for the railway are to be supplied by the Metropolitan-Cammell Carriage, Wagon & Finance Company, Limited.

The motor vessel "Silver Sandal," built by Messrs. Harland & Wolff, Limited, for the Silver Line, Limited, has recently completed successful trials. The "Silver Sandal" has a gross tonnage of 6,770 and is the last of four similar vessels built by Messrs. Harland & Wolff for the Silver Line.

It is understood that the Government contemplate the setting up of a committee to consider a scheme for the buying and scrapping of old shipping tonnage. The basic task of the committee would be to examine the suggestion that shipowners should form a pool and, assisted by the Government, purchase annually for scrapping a proportion of tonnage over 20 years old.

Notice has been given to the employees at the Dowlais (Merthyr) works of the British (Guest Keen Baldwins) Iron & Steel Company, Limited, which were recently reopened after a stoppage of seven weeks' duration, to terminate employment and placing each one on day-to-day contracts. A notice posted by the management states that they are compelled to take this step owing to the severe trade depression.

We understand that the first section of the new works of Messrs. John G. Stein & Company, Limited, at Manuel, Scotland, is now in full operation. These works have been built on the most modern lines, and embody all the best developments and technique known to the refractories industry. "Nettle" brand 43 per cent. alumina firebricks will be manufactured in this plant. For the past five years these bricks have been made at the Castlecary Works. During this period invaluable experience has been gained and the standard of quality has been steadily raised. The results of this experience have been embodied in the new plant.

The Dneprostal (Dnieper Steel) Works, of Russin, has awarded a contract for the designing of two open-hearth steel plants, consisting of nine 250-ton stationary furnaces for one plant and six 250-ton tilting furnaces for another plant, to the S. R. Smythe Company, Inc., of Pittsburgh. The Smythe Company will also act as consulting engineers on the general arrangement of the entire steel plant. The plant will include six 1,000-ton blast furnaces, and the finishing capacity will embrace facilities for the production of about 1,000,000 tons of hot-rolled products. The second plant, to have an annual capacity of about 500,000 tons, will make alloy and tool steels principally.

The Canadian Government's Anti-Dumping Bill to reduce unemployment was read a first time in the House of Commons on Tuesday, September 16. It involves an upward revision of the rates, particularly on textiles, agricultural implements, some iron and steel products and heating and electric apparatus. Cabled reports state that the British preferential on tinplate and other tin manufactures is raised from 15 to 20 per cent. The duty on pig-iron is increased by 75 cents per ton for British preference and $1.25 on intermediate and general rates. The British preference rate on bars, rods, iron and steel (hot rolled) is increased by $2.12½, and intermediate and general rates by $3.50. Coal is increased by 15, 20 and 30 per cent. respectively.

Sir Ernest W. Petter, chairman of Messrs. Petters, Limited, of Yeovil, has written to Mr. William Graham, President of the Board of Trade, protesting against the ratification by Great Britain of the tariff truce, and resigning from the Advisory Council of the Board of Trade. Sir Ernest Petter was for two successive years the President of the British Engineers' Association (1923-24, 1924-25), and is a member of the Council of the Federation of British Industries and a member of the Council of the Institution of Mechanical Engineers. In his letter Sir Ernest Petter says that he has read with grave concern Mr. Graham's statement, made to the League Assembly at Geneva recently, that Great Britain would ratify the tariff truce. The effect of this policy is the acquiescence by this country for a prolonged period in the present unfair conditions under which our home market is exposed to the dumping of foreign manufacturers, made under conditions not permitted by British trade-union regulations, while foreign markets continue under their existing tariffs to be closed against the products of our own people.

At a conference of the Industrial Co-Partnership Association, at Leeds recently, addresses were delivered by Professor J. H. Jones, Professor of Economics and head of the Commerce Department of Leeds University, and Dr. James Bowie, Director of the Industrial Administration Department of the Manchester College of Technology. For this country, Professor Jones said, the downward trend of world prices since 1924 was a more important phenomenon than the "slump" in trade, which in the trade cycle would be followed in the near future by world recovery. Until wages had been adjusted to the gold standard and the requirements of existing world conditions, he saw no hope that British industry would receive its full share in the coming "boom." Rationalisation, which was a defensive rather than an attacking movement, might prevent the further growth of unemployment, but it would not make much impression upon the million who were unemployed before the present cyclical depression set in. Until wages had been adjusted to fit the transition from a paper standard to a gold standard and the world fall in prices, he saw no hope of the restoration of British industry beyond the stage it had reached before the present depression. Dr. Bowie, in an address on rationalisation and unemployment, said that rationalisation in Britain was bound to stimulate great activity in the constructional and engineering industries for at least a decade. But rationalisation was only one contribution to the reduction of costs. The great danger was that the savings it effected might be used as a lever to inflate other costs, such as taxation or wage rates.

## New Companies.

**Phœnix Steel Tube Company, Limited,** Phœnix Street, West Bromwich.—Capital £10,000 in £1 shares.

**Thomas Madeley, Limited.**—Capital £10,000. Brassfounders, etc. Directors: T. Madeley (permanent director and chairman), 261, Grove Lane, Handsworth, Birmingham; and C. H. Madeley.

**John Dudgill & Company, Limited,** Buxton Road, Norbury, Hazel Grove, Cheshire.—Capital £10,000. Electrical fittings manufacturers, etc. Directors: H. F. Dudgill, Dora Dudgill and Mrs. M. Gosling.

**Universal Rustless Steel Corporation, Limited,** Holmwood, Ecclesall Road, Sheffield.—Capital £165,000 in 150,000 7½ per cent. preferred ordinary shares of £1 each and 300,000 deferred shares of 1s. each, to adopt an agreement with P. R. Kuehnrich, and to carry on the business of ironfounders, steelmakers, etc.

## Personal.

Mr. D. D. Walker has recently been appointed engineer and sales manager of the Disc-Bar Mills, Limited, Buckingham House, Buckingham Street, London, W.C.2.

Mr. F. H. Chapin, President of the National Acme Company, of Cleveland, America, is now spending a five-weeks' business visit in England, France and Germany.

Col. Sir Henry G. Lyons, F.R.S., has accepted the invitation of the Council of the Junior Institution of Engineers to become President in succession to Sir Ernest W. Moir, Bt. His induction will take place at a meeting to be held on December 12 at the Royal Society of Arts.

Mr. William McRae, of Hamilton, is retiring from the staff of Messrs. Archibald Baird & Son, Limited, Clyde Steel Works, Hamilton, on September 27, on completion of 36 years' service. During the major part of this time Mr. McRae had charge of the engineering department.

Mr. R. D. Lawrie, who has been with Messrs. Newton Chambers & Company, Limited, Thorncliffe Iron Works, near Sheffield, for some time, is taking up the position of assistant foundry manager to Messrs. Glenfield & Kennedy, Limited, Kilmarnock. Mr. Lawrie was previously assistant to Mr. J. E. Hurst at Centrifugal Castings, Limited, Kilmarnock.

Mr. Edgar E. Brosius, President of Edgar E. Brosius, Incorporated, of Pittsburgh, U.S.A., builders of blast-furnace and steel-plant equipment, is now making an extended tour of the Continent and this country, in connection with the manufacture and distribution of his company's equipment. Mr. Brosius intends to visit blast furnaces and steel plant in the British Isles and on the Continent.

Mr. P. B. Brown was last week elected Master Cutler of Sheffield for the ensuing year. Mr. Brown is deputy-chairman and managing director of Messrs. Hadfields, Limited, Sheffield. He has been connected with the firm for 42 years, having started, at the age of 22, as assistant manager and draughtsman. He had previously served an apprenticeship to engineering with Messrs. Easton & Anderson, of Erith, and in Sheffield he continued his education, studying metallurgy at the University. He has seen Messrs. Hadfields, Limited, grow from a small firm, engaged principally on the production of steel castings and employing 300 or 400 men, to a concern with between 5,000 and 6,000 employees. Mr. Brown has taken a prominent part in the development of the firm. He is the second member of the company to become Master Cutler, the chairman, Sir Robert Hadfield, Bt., having held the office in 1899-1900.

### Wills.

Blagburn, G. H., of Tynemouth Road, North Shields, iron and scrap merchant ... ... ... ... ... £11,655

Crush, S. T., a director of Messrs. Yarrow & Company, Limited, shipbuilders and engineers, of Scotstoun, near Glasgow ... ... ... ... £17,102

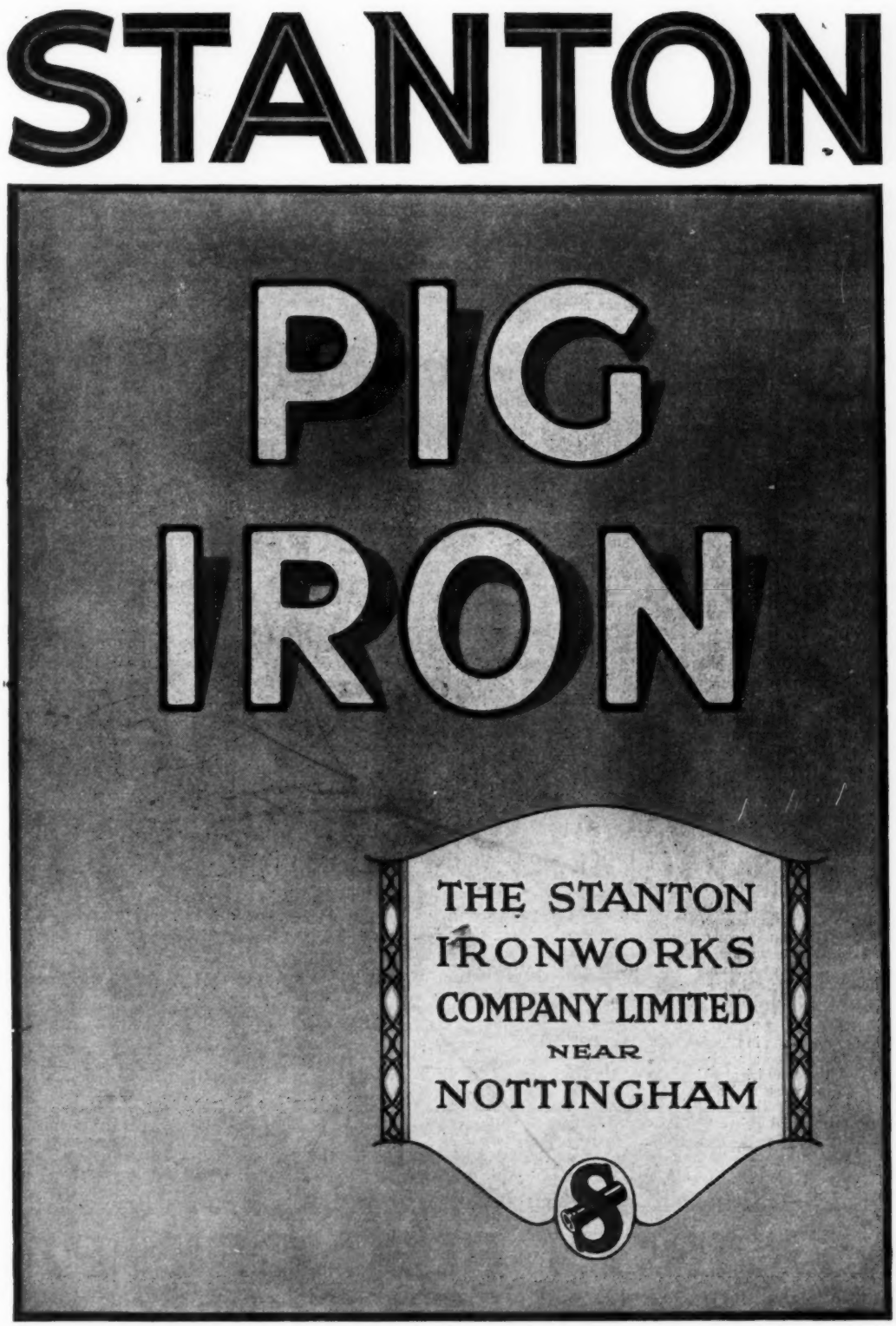
## Obituary.

Mr. John B. Hamilton, assistant manager of the Dalzell Steel & Iron Works of Messrs. David Colville & Sons, Limited, Motherwell, died suddenly on September 10.

Mr. Jean Ramaekers, the chairman of directors of Messrs. the Zeelhem Foundry Company, Limited, Belgium, died recently. He was mayor of his town and occupied many public positions. His work was recognised by the bestowal of several decorations by both State and church.

The death occurred suddenly on September 18 of Mr. Hugh H. MacTaggart, head of Messrs. MacTaggart, Scott & Company, Limited, engineers, of Loanhead, Midlothian. Mr. MacTaggart served his time as an engineer with Messrs. Brown Bros., Limited, Rosebank Iron Works, Edinburgh, and subsequently became works manager. About 30 years ago he entered into partnership with Mr. R. G. Scott, and soon was carrying out work for home and foreign shipowners and also for British and foreign navies. During the war Mr. MacTaggart rendered valuable service to the British Admiralty, devising, amongst other things, methods of controlling the submersion of submarines, working periscopes and silencing the engines.

XUM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PIG
IRON
THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

# Iron and Steel Markets.

## Pig-Iron.

**MIDDLESBROUGH.**—Movements in the market for Cleveland iron are again restricted in the absence of an active demand, and in the meantime there seems some disposition on the part of consumers to return to their former attitude of purchasing only for the most pressing needs or urgent emergency orders. External circumstances are, perhaps, partially responsible for the present reaction, rather sanguine expectations having been recently entertained of a substantial influx of orders on shipbuilding account on Clydeside and elsewhere, which, unfortunately, have failed to materialise. More encouraging, however, is the report that in some cases forward contracts have been placed; but most of the orders are for delivery before the end of October, and in the aggregate they appear to be sufficient to absorb the surplus output. Further expansion would speedily enable makers to disperse their stocks, and thereafter they might be prepared to consider the relighting of a few more furnaces. As concerns shipments, the export of Cleveland pig-iron to near European ports appears to have virtually ceased—most of the iron shipped from the Tees is hematite or special iron—and it is the extent of the home demand which is the more immediate concern of the Cleveland ironmaster. Prices may be repeated as follow:—No. 1 Cleveland foundry iron, 66s.; No. 3 Cleveland G.M.B., 63s. 6d.; No. 4 foundry, 62s. 6d.; No. 4 forge, 62s. per ton.

Contrasted with the conditions just outlined in the foundry section of the trade, the outlook in the market for East Coast hematite is distinctly more satisfactory than has been experienced for some time past. This is to be attributed to a gradual expansion in the demand for this quality of pig-iron. Home consumers are displaying a greater readiness to accept deliveries under contract, and in some cases have made fresh purchases. But in addition a number of sales abroad have been negotiated in the face of keen competition. The home quotation for mixed numbers is a shade firmer at 71s., with 6d. extra per ton for No. 1 quality. On the North-West Coast, Bessemer mixed numbers are quoted at 70s. per ton at works.

**LANCASHIRE.**—Reports from the various centres of the foundry industry in this area confirm previous impressions of continued slackness, with only a very moderate demand for pig-iron at the moment. As at the forthcoming meeting of the Midland furnace proprietors, it is not anticipated that any change in prices will result, the ruling quotations may be repeated as follow:—No. 3 Derbyshire, 72s.; No. 3 Staffordshire, 72s.; Scotch brands, 92s. 6d., all delivered equal Manchester.

**THE MIDLANDS.**—Throughout the Black Country districts ironfounders continue to complain of the paucity of business, and, in the main, they are content to purchase odd lots of pig-iron to cover immediate needs rather than enter the market by contracting for forward supplies. Prices are unchanged at 70s. for No. 3 Northants and 73s. 6d. for Derbyshire and Staffordshire No. 3, delivered local stations or sidings.

**SCOTLAND.**—Extreme quietness in trade continues among the founders, and there are no signs of improvement yet. Some of the foundries which are occupied particularly on marine work and specialties are practically closed down, with the result that there is no demand for pig-iron and prices continue to be weak. Scotch foundry iron is still quoted by the makers at 76s. 6d. f.o.t. furnaces, but there is practically no business moving.

## Finished Iron.

At Birmingham the market for this class of material continues sluggish, the position being altogether unsatisfactory in so far as it concerns crown and the cheaper grades of iron. The mills are working intermittently, and prices are being shaded for anything like a desirable order. Average figures would be £10 to £10 5s. for crown iron, and about £9 for the nut and bolt grade. The figure of £12 10s. for Staffordshire marked bars is maintained, and the makers of these continue to be fairly well occupied. Of course, the trouble in this district, as it concerns chiefly the manufacturers of nut and bolt iron, is caused by the low prices at which foreign material can be obtained.

## Steel.

At Sheffield the depressed state of the steel market persists, and buying of acid and basic billets shows little variation. Continental billets at low prices hamper business in home billets, being quoted at figures which make the prices of British billets appear high. Wire-rod makers are also suffering in the same manner. While the output of open-hearth steel is comparatively small and shows no likelihood of early expansion, there is a big demand for stainless and the highest classes of steel. The output of crucible steel is moderate. There is a better inquiry for cold-rolled steel and strip. Overseas business in steel is disappointingly small. The tinplate market continues quiet, and with the object of stimulating orders the makers have reduced the quotation by 1s. to 17s. basis for coke quality, net cash, f.o.b. South Wales ports.

## Scrap.

The business passing in this class of foundry material is still on a limited scale, and prices in most cases are still marked a shade easier. On Tees-side the heavy foundries are very slack, and in some cases are working short time. Heavy cast iron is, therefore, in quiet demand, but prices are unchanged, with ordinary quality at 55s. and machinery quality at 57s. 6d. In the Midlands there is still a fair demand for cast-iron scrap, 62s. 6d. to 65s. being offered by local foundries for heavy machinery cast-iron scrap in cupola sizes, 57s. 6d. to 60s. for heavy metal and 47s. 6d. to 50s. for light cast iron. In Scotland the demand for cast-iron borings is a little better at 34s. to 35s., heavy machinery cast-iron scrap, suitable for foundries, is unchanged at 62s. 6d. to 63s. 6d., ordinary cast-iron scrap is 56s. to 57s., and for old railway chairs 57s. 6d. to 58s. 6d. is quoted, with light metal at 45s. The above prices are all per ton delivered f.o.t. consumers' works.

## Metals.

**Copper.**—At last week's closing market the price of standard copper recorded a further decline, which has carried the quotation down to a new low level, and the support formerly afforded as soon as the price fell below £47 seems to have been withdrawn. Despite the announcement that no further reduction in price is to be made, the market is not inclined to regard the future with confidence. The latest price reductions have not, it is stated, led to any increased business.

Closing quotations:—

*Cash.*—Thursday, £46 2s. 6d. to £46 3s. 9d.; Friday, £45 13s. 9d. to £45 15s.; Monday, £45 11s. 3d. to £45 12s. 6d.; Tuesday, £45 5s. to £45 7s. 6d.; Wednesday, £45 5s. to £45 6s. 3d.

*Three Months.* — Thursday, £46 3s. 9d. to £46 5s.; Friday, £45 13s. 9d. to £45 15s.; Monday, £45 12s. 6d. to £45 13s. 9d.; Tuesday, £45 7s. 6d. to £45 8s. 9d.; Wednesday, £45 3s. 9d. to £45 5s.

**Tin.**—The market for standard tin also developed further weakness at the week-end. In the East sales are still below normal, and the effect of curtailment of ore production is making itself felt in smaller deliveries and shipments. Stocks in this country are still very high, but there is at long last some suggestion that the increase has been checked and a beginning made to the long task of reducing them to more manageable dimensions

Official closing prices:—

*Cash.*—Thursday, £134 to £134 2s. 6d.; Friday, £133 10s. to £133 12s. 6d.; Monday, £132 to £132 2s. 6d.; Tuesday, £131 15s. to £132; Wednesday, £132 15s. to £132 17s. 6d.

*Three Months.*—Thursday, £135 12s. 6d. to £135 15s.; Friday, £135 to £135 2s. 6d.; Monday, £133 12s. 6d. to £133 15s.; Tuesday, £133 10s. to £133 12s. 6d.; Wednesday, £134 5s. to £134 7s. 6d.

**Spelter.**—Dull and uninteresting conditions continue without indication of any impending change in sentiment. Of the Zinc Cartel there is no fresh news, and consumers are limiting their purchases to small parcels, a disappointing feature being the lack of demand for high-grade zinc, a quality which commands as a rule a steady sale even in bad times.

Daily fluctuations:—

*Ordinary.*—Thursday, £15 18s. 9d.; Friday, £15 18s. 9d.; Monday, £15 16s. 3d.; Tuesday, £15 10s.; Wednesday, £15 10s.

**Lead.**—Narrow fluctuations have occurred, but on the whole the market is devoid of interest and shows no signs of any impending change in either direction. Consumers bought rather sparingly and are still not inclined in the majority of cases to book very far ahead.

The week's prices have been:—

*Soft Foreign (Prompt).*—Thursday, £17 12s. 6d.; Friday, £17 12s. 6d.; Monday, £17 16s. 3d.; Tuesday, £17 15s.; Wednesday, £17 17s. 6d.

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**Wellman Smith Owen Engineering Corporation, Limited.**—The annual meeting of the Wellman Smith Owen Engineering Corporation, Limited, was held in London recently. Mr. James Foster-Smith, who presided, said: At the last meeting the board were able to report that the company's position showed considerable improvement, and I am glad to confirm that this continues and that steady progress has been made. You may recall that last year we referred to the policy the board was pursuing of consolidating the company's business abroad and in countries which had proceeded more slowly and more surely with stabilisation than this country. This policy has proved of great benefit to the company, and I would mention that the amount of work we have in hand at present for shipment and for installation in the Empire overseas and on the Continent of Europe greatly exceeds the value of contracts in hand for the home market. Our subsidiary company in South Africa is now definitely established on a trading basis, and contracts to a substantial value have been carried out in that territory. While an immediate revival of prosperity in the heavy iron and steel industries of this country cannot be definitely predicted, there is a gradual improvement in this direction, and the directors are confident that, equipped as we are to serve the iron and steel industries of the world, a prospect of increasing prosperity lies before the company.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

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# SERVICE

TO supply the exact grade of iron you want for your particular job and deliver it with all speed—that is part of the Bradley Service.

**BRADLEY'S MAINTAIN LARGE AND VARIED STOCKS**

of Pig Iron to suit all purposes. Urgent requests can usually be filled immediately and every consignment is analysed before it goes out.

Bradley's REFINED
**PIG IRON**
**"A QUALITY FOR EVERY REQUIREMENT"**

**BRADLEY & FOSTER, LIMITED**
**DARLASTON, STAFFS**

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Special CARBON BLACKING

67 MADE BY A FIRM WITH YEARS EXPERIENCE.

JAS. DURRANS & SONS. LIMITED.
PHŒNIX WORKS PENISTONE. NR. SHEFFIELD.

Also—
GANISTER, LOAM AND SAND MILLS.
STUDS, CHAPLETS, BRUSHES, CORE ROPES, BUCKETS, SPADES, Etc. LADLES, FIRE BRICKS, STONE FLUX, CASTING CLEANERS, PIPE NAILS, SPRIGS, WIRE BRUSHES, BELLOWS,

PLUMBAGO
CORE GUM
WHITE DUST
COAL DUST
REQUISITES

# WEEKLY PRICE CURRENT.

## COPPER.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 45 | 5 | 0 |
| Three months | 45 | 3 | 9 |
| Electrolytic | 49 | 0 | 0 |
| Tough | 47 | 10 | 0 |
| Best selected | 48 | 0 | 0 |
| Sheets | 77 | 0 | 0 |
| India | 60 | 0 | 0 |
| Wire bars | 49 | 17 | 6 |
| Do. October | 49 | 17 | 6 |
| Do. November | 49 | 17 | 6 |
| Ingot bars | 49 | 17 | 6 |
| H.C. wire rods | 51 | 15 | 0 |
| Off. av. cash, August | 47 | 11 | 4½ |
| Do., 3 mths., August | 47 | 12 | 5½ |
| Do., Sttlmnt., August | 47 | 11 | 3 |
| Do., Electro, August | 51 | 4 | 6 |
| Do., B.S., August | 50 | 14 | 8¾ |
| Do., wire bars, August | 51 | 14 | 6 |
| Solid drawn tubes | | | 11½d. |
| Brazed tubes | | | 11½d. |
| Wire | | | 8½d. |

## BRASS.

| | |
|---|---|
| Solid drawn tubes | 10½d. |
| Brazed tubes | 12½d. |
| Rods, drawn | 10½d. |
| Rods, extd. or rlld. | 9½d. |
| Sheets to 10 w.g. | 8½d. |
| Wire | 8½d. |
| Rolled metal | 8½d. |
| Yellow metal rods | 6d. |
| Do. 4 × 4 Squares | 6½d. |
| Do. 4 × 3 Sheets | 7½d. |

## TIN.

| | £ | s. | d. |
|---|---|---|---|
| Standard cash | 132 | 15 | 0 |
| Three months | 134 | 5 | 0 |
| English | 133 | 15 | 0 |
| Bars | 134 | 15 | 0 |
| Straits | 133 | 12 | 6 |
| Australian | 132 | 17 | 6 |
| Eastern | 137 | 15 | 0 |
| Banca | 135 | 15 | 0 |
| Off. av. cash, August | 135 | 1 | 2½ |
| Do., 3 mths., August | 136 | 14 | 6¾ |
| Do., Sttlmt., August | 135 | 1 | 6 |

## SPELTER.

| | £ | s. | d. |
|---|---|---|---|
| Ordinary | 15 | 10 | 0 |
| Remelted | 14 | 7 | 6 |
| Hard | 11 | 17 | 6 |
| Electro 99.9 | 17 | 12 | 6 |
| English | 15 | 7 | 6 |
| India | 14 | 0 | 0 |
| Zinc dust | 21 | 10 | 0 |
| Zinc ashes | 4 | 0 | 0 |
| Off. aver., August | 16 | 4 | 2½ |
| Aver., spot, August | 15 | 19 | 0¾ |

## LEAD.

| | £ | s. | d. |
|---|---|---|---|
| Soft foreign ppt. | 17 | 17 | 6 |
| English | 19 | 5 | 0 |
| Off. average, August | 18 | 4 | 8½ |
| Average spot, August | 18 | 5 | 10½ |

## ZINC SHEETS, &c.

| | £ | s. | d. |
|---|---|---|---|
| Zinc sheets, English | 26 | 0 | 0 |
| Do. V.M. ex-whf. | 25 | 0 | 0 |
| Rods | 30 | 0 | 0 |
| Boiler plates | 21 | 0 | 0 |
| Battery plates | 22 | 10 | 0 |

## ANTIMONY.

| | £ | s. | d. |
|---|---|---|---|
| Special brands, Eng. | 38 | 0 | 0 |
| Chinese | 26 | 10 | 0 |
| Crude | 22 | 0 | 0 |

## QUICKSILVER.

| | £ | s. | d. |
|---|---|---|---|
| Quicksilver | 22 | 10 | 0 |

## FERRO-ALLOYS AND STEEL-MAKING METALS.

| | |
|---|---|
| Ferro-silicon— | |
| 25% | 7 17 6 |
| 45/50% | 11 10 0 |
| 75% | 18 10 0 |
| Ferro-vanadium— | |
| 35/50% | 12/8 lb. Va. |
| Ferro-molybdenum— | |
| 70/75% c. free | 4/2 lb. Mo. |
| Ferro-titanium— | |
| 23/25% carbon-free | 11½d. lb. |
| Ferro-phosphorus, 20/25% | £16 0 0 |
| Ferro-tungsten— | |
| 80/85% | 2/3 lb. |
| Tungsten metal powder— | |
| 98/99% | 2/6 lb. |
| Ferro-chrome— | |
| 2/4% car. | £30 10 0 |
| 4/6% car. | £23 5 0 |
| 6/8% car. | £22 5 0 |
| 8/10% car. | £22 0 0 |
| Ferro-chrome— | |
| Max. 2% car. | £33 10 0 |
| Max. 1% car. | £37 15 0 |
| Max. 0.70% car. | £42 5 0 |
| 70% carbon-free | 11d. lb. |
| Nickel—99% cubes, or pellets | £175 0 0 |
| Ferro-cobalt | 9/7 lb. |
| Aluminium 98/99% | £95 0 0 |
| Metallic chromium— | |
| 96/98% | 2/7 lb. |
| Ferro-manganese (net)— | |
| 76/80% loose | £11 0 0 to £11 15 0 |
| 76/80% packed | £12 0 0 to £12 15 0 |
| 76/80% export | £10 10 0 to £11 0 0 |
| Metallic manganese— | |
| 94/96% carbonless | 1/4 lb. |

Per ton unless otherwise stated.

## HIGH-SPEED TOOL STEEL.

| | |
|---|---|
| Finished bars, 14% tungsten | £0 2 2 |
| Finished bars, 18% tungsten | £0 3 0 |

Per lb. net, d/d buyers' works.

Extras—

| | |
|---|---|
| Rounds and squares, 3 in. and over | 4d. lb. |
| Rounds and squares, under ½ in. to ¼ in. | 3d. lb. |
| Do., under ¼ in. to $\frac{3}{16}$ in. | 1/- lb. |
| Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. | 3d. lb. |
| Do., under ½ in. × ¼ in. | 1/- lb. |
| Bevels of approved sizes and sections | 6d. lb. |

Bars cut to length, 10% extra.

## SCRAP.

| South Wales— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Heavy steel | | | | 2 | 15 | 0 |
| Bundled steel and shrngs. | 2 | 10 | 0 to | 2 | 13 | 0 |
| Mixed iron and steel | 2 | 7 | 6 to | 2 | 10 | 0 |
| Heavy cast iron | 2 | 13 | 6 to | 2 | 14 | 6 |
| Good machinery for foundries | | | | 2 | 17 | 6 |
| Cleveland— | | | | | | |
| Heavy steel | | | | 2 | 7 | 6 |
| Steel turnings | | | | 1 | 17 | 6 |
| Cast-iron borings | | | | 1 | 12 | 6 |
| Heavy forge | | | | 3 | 5 | 0 |
| W.I. piling scrap | | | | 3 | 1 | 6 |
| Cast-iron scrap | 2 | 15 | 0 to | 2 | 17 | 6 |
| Midlands— | | | | | | |
| Ord. cast-iron scrap | 2 | 7 | 6 to | 2 | 10 | 0 |
| Heavy wrought | 2 | 12 | 6 to | 2 | 15 | 0 |
| Steel turnings | 1 | 7 | 6 to | 1 | 10 | 0 |
| Scotland— | | | | | | |
| Heavy steel | | | | 2 | 10 | 0 |
| Ordinary cast iron | | | | 2 | 16 | 0 |
| Engineers' turnings | | | | 1 | 16 | 6 |
| Cast-iron borings | | | | 1 | 14 | 0 |
| Wrought-iron piling | | | | 3 | 7 | 6 |
| Heavy machinery | | | | 3 | 3 | 0 |

London—Merchants' buying prices delivered yard.

| | £ | s. | d. |
|---|---|---|---|
| Copper (clean) | 41 | 0 | 0 |
| Brass | 30 | 10 | 0 |
| Lead (less usual draft) | 15 | 10 | 0 |
| Tea lead | 12 | 0 | 0 |
| Zinc | 9 | 0 | 0 |
| New aluminium cuttings | 56 | 0 | 0 |
| Braziery copper | 38 | 0 | 0 |
| Gunmetal | 41 | 0 | 0 |
| Hollow pewter | 100 | 0 | 0 |
| Shaped black pewter | 75 | 0 | 0 |

## PIG-IRON.

*(f.o.t. unless otherwise stated.)*

| | |
|---|---|
| N.E. Coast— | |
| Foundry No. 1 | 66/- |
| Foundry No. 3 | 63/6 |
| Foundry No. 4 | 62/6 |
| Forge No. 4 | 62/- |
| Hematite No. 1 | 71/6 |
| Hematite M/Nos. | 71/- |
| N.W. Coast— | |
| Hem. M/Nos. d/d Glas. | 80/- |
| „ d/d Birm. | 88/6 |
| Midlands— | |
| Staffs. common* | — |
| „ No. 4 forge* | 68/6 |
| „ No. 3 fdry.* | 73/6 |
| Shrops. basic | — |
| „ Cold blast, ord. | — |
| „ „ roll iron | — |
| Northants forge* | 65/- |
| „ fdry. No. 3* | 70/- |
| Derbyshire forge* | 68/6 |
| „ fdry. No. 3* | 73/6 |
| „ basic* | — |
| *d/d Black Country dist. | |
| Scotland— | |
| Foundry No. 1 | 79/- |
| „ No. 3 | 76/6 |
| Hem. M/Nos. | 78/- |
| Sheffield (d/d district)— | |
| Derby forge | 63/6 |
| „ fdry. No. 3 | 68/6 |
| Lincs. forge | — |
| „ fdry. No. 3 | 70/- |
| E.C. hematite | 83/6 |
| W.C. hematite | 86/6 |
| Lincs. (at furnaces)— | |
| Forge No. 4 | — |
| Foundry No. 3 | — |
| Basic | — |
| Lancashire (d/d eq. Man.)— | |
| Derby forge | 67/- |
| „ fdry. No. 3 | 72/- |
| Staffs foundry No. 3 | 72/- |
| Dalzell, No. 3 (special) | 105/- to 107/6 |
| Summerlee, No. 3 | 92/6 |
| Glengarnock, No. 3 | — |
| Eglinton, No. 3 | 92/6 |
| Gartsherrie, No. 3 | 92/6 |
| Monkland, No. 3 | 92/6 |
| Shotts, No. 3 | 92/6 |

## FINISHED IRON AND STEEL.

*Usual District deliveries for iron; delivered consumers' station for steel.*

| Iron— | £ | s. | d. | £ | s. | d. |
|---|---|---|---|---|---|---|
| Bars (cr.) | 10 | 0 | 0 to | 10 | 15 | 0 |
| Nut and bolt iron | | | | 9 | 0 | 0 |
| Hoops | 10 | 15 | 0 to | 12 | 0 | 0 |
| Marked bars (Staffs) f.o.t. | | | | 12 | 10 | 0 |
| Gas strip | 10 | 15 | 0 to | 12 | 0 | 0 |
| Bolts and nuts, ¾ in. × 4 in. | 15 | 5 | 0 | | | |
| Steel— | | | | | | |
| Ship plates | 8 | 15 | 0 to | 8 | 17 | 6 |
| Boiler plts. | 9 | 15 | 0 to | 10 | 10 | 0 |
| Chequer plts. | | | | 10 | 12 | 6 |
| Angles | | | | 8 | 7 | 6 |
| Tees | | | | 9 | 7 | 6 |
| Joists | | | | 8 | 10 | 0 |
| Rounds and squares, 3 in. to 5½ in. | | | | 9 | 7 | 6 |
| Rounds under 3 in. to ¾ in. (Untested) | | | | 7 | 15 | 0 |
| | | | | and upwards | | |
| Flats—8 in. wide and over | | | | 8 | 12 | 6 |
| „ under 8 in. and over 5 in. | | | | 8 | 17 | 6 |
| Rails, heavy | | | | 8 | 10 | 0 |
| Fishplates | | | | 12 | 0 | 0 |
| Hoops (Staffs) | 9 | 5 | 0 to | 9 | 15 | 0 |
| Black sheets, 24 g. | 9 | 12 | 6 to | 9 | 15 | 0 |
| Galv.cor.shts., 24g. | | | | 11 | 12 | 6 |
| Galv. fencing wire, 8g. plain | | | | 12 | 0 | 0 |
| Billets, soft | 5 | 15 | 0 to | 6 | 5 | 0 |
| Billets, hard | 7 | 10 | 0 to | 8 | 0 | 0 |
| Sheet bars | 5 | 15 | 0 to | 6 | 0 | 0 |
| Tin bars | | | | 6 | 0 | 0 |

## PHOSPHOR BRONZE.

| | Per lb. basis. |
|---|---|
| Strip | 1/0¾ |
| Sheet to 10 w.g. | 1/1¼ |
| Wire | 1/1¼ |
| Rods | 1/1 |
| Tubes | 1/5¾ |
| Castings | 1/1¼ |

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

## NICKEL SILVER, &c.

| | per lb. |
|---|---|
| Ingots for raising | 8d. to 1/2 |
| Rolled— | |
| To 9 in. wide | 1/2 to 1/8 |
| To 12 in. wide | 1/2¼ to 1/8¼ |
| To 15 in. wide | 1/2½ to 1/8½ |
| To 18 in. wide | 1/3 to 1/9 |
| To 21 in. wide | 1/3¼ to 1/9¼ |
| To 25 in. wide | 1/4 to 1/10 |
| Ingots for spoons and forks | 8d. to 1/4¼ |
| Ingots rolled to spoon size | 11d. to 1/7¼ |
| Wire round— | |
| 3/0 to 10 G. | 1/5½ to 2/0½ |

with extras according to gauge.

## AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

| | Dols. |
|---|---|
| No. 2 foundry, Phila. | 19.76 |
| No. 2 foundry, Valley | 18.00 |
| No. 2 foundry, Birm. | 14.00 |
| Basic | 19.76 |
| Bessemer | 20.26 |
| Malleable | 20.26 |
| Grey forge | 19.26 |
| Ferro-mang. 80% | 94.00 |
| O.-h. rails, h'y, at mill | 43.00 |
| Billets | 31.00 |
| Sheet bars | 31.00 |
| Wire rods | 36.00 |
| | Cents. |
| Iron bars, Phila. | 2.09 |
| Steel bars | 1.60 |
| Tank plates | 1.60 |
| Beams, etc. | 1.60 |
| Skelp, grooved steel | 1.70 |
| Skelp, sheared steel | 1.70 |
| Steel hoops | 1.95 |
| Sheets, black, No. 24 | 2.40 |
| Sheets, galv., No. 24 | 3.00 |
| Sheets, blue an'l'd, No. 13 | 2.05 |
| Wire nails | 2.00 |
| Plain wire | 2.30 |
| Barbed wire, galv. | 2.70 |
| Tinplates, 100-lb. box | $5.25 |

## COKE (at ovens).

| | |
|---|---|
| Welsh foundry | 25/- to 27/6 |
| „ furnace | 17/6 to 21/6 |
| Durham and Northumberland— | |
| „ foundry | 15/- to 15/6 |
| „ furnace | 14/6 |
| Midlands, foundry | — |
| „ furnace | — |

## TINPLATES.

f.o.b. Bristol Channel ports.

| | | | |
|---|---|---|---|
| I.C. cokes | 20×14 box | | 18/- |
| „ | 28×20 „ | | 36/- |
| „ | 20×10 „ | | 26/- |
| „ | 18¾×14 „ | | 18/9 |
| C.W. | 20×14 „ | | 16/- |
| „ | 28×20 „ | | 33/6 |
| „ | 20×10 „ | | 23/6 |
| „ | 18¾×14 „ | | 17/- |
| Terneplates | 28×20 | | 32/6 per box basis f.o.b. |

## SWEDISH CHARCOAL IRON & STEEL.

| | | | | | | |
|---|---|---|---|---|---|---|
| Pig-iron | £6 | 0 | 0 | to | £7 | 10 0 |
| Bars, hammered, basis | £17 | 10 | 0 | to | £18 | 10 0 |
| Bars and nail-rods, rolled, basis | £15 | 17 | 6 | to | £16 | 15 0 |
| Blooms | £10 | 0 | 0 | to | £12 | 0 0 |
| Keg steel | £32 | 0 | 0 | to | £33 | 0 0 |
| Faggot steel | £20 | 0 | 0 | to | £24 | 0 0 |
| Bars and rods dead soft, steel | £11 | 0 | 0 | to | £14 | 0 0 |

All per English ton, f.o.b. Gothenburg.

### TUBES AND FITTINGS.

Over ⅛ in. up to 6 in.

| | *Tubes.* | *Fittings.* |
|---|---|---|
| Gas .. .. | 62½% | 47½% |
| Water .. | 58½% | 42½% |
| Steam .. | 55% | 37½% |

W.I. 12½% extra.

### DAILY FLUCTUATIONS.

**Standard Copper** (cash).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 46 | 2 | 6 | No change | |
| ,, 19 .. | 45 | 13 | 9 | dec. | 8/9 |
| ,, 22 .. | 45 | 11 | 3 | ,, | 2/6 |
| ,, 23 .. | 45 | 5 | 0 | ,, | 6/3 |
| ,, 24 .. | 45 | 5 | 0 | No change | |

**Electrolytic Copper.**

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 49 | 0 | 0 | No change | |
| ,, 19 .. | 49 | 0 | 0 | ,, | ,, |
| ,, 22 .. | 49 | 0 | 0 | ,, | ,, |
| ,, 23 .. | 49 | 0 | 0 | ,, | ,, |
| ,, 24 .. | 49 | 0 | 0 | ,, | ,, |

**Standard Tin** (cash).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 134 | 0 | 0 | No change | |
| ,, 19 .. | 133 | 10 | 0 | dec. | 10/- |
| ,, 22 .. | 132 | 0 | 0 | ,, | 30/- |
| ,, 23 .. | 131 | 15 | 0 | ,, | 5/- |
| ,, 24 .. | 132 | 15 | 0 | inc. | 20/- |

**Tin** (English ingots).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 135 | 0 | 0 | No change | |
| ,, 19 .. | 134 | 10 | 0 | dec. | 10/- |
| ,, 22 .. | 133 | 0 | 0 | ,, | 30/- |
| ,, 23 .. | 132 | 15 | 0 | ,, | 5/- |
| ,, 24 .. | 133 | 15 | 0 | inc. | 20/- |

**Zinc Sheets** (English).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 26 | 0 | 0 | No | change |
| ,, 19 .. | 26 | 0 | 0 | ,, | ,, |
| ,, 22 .. | 26 | 0 | 0 | ,, | ,, |
| ,, 23 .. | 26 | 0 | 0 | ,, | ,, |
| ,, 24 .. | 26 | 0 | 0 | ,, | ,, |

**Spelter** (ordinary).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 15 | 18 | 9 | No change | |
| ,, 19 .. | 15 | 18 | 9 | ,, | ,, |
| ,, 22 .. | 15 | 16 | 3 | dec. | 2/6 |
| ,, 23 .. | 15 | 10 | 0 | ,, | 6/3 |
| ,, 24 .. | 15 | 10 | 0 | No change | |

**Lead** (English).

| | | £ | s. | d. | |
|---|---|---|---|---|---|
| Sept. 18 .. | 19 | 0 | 0 | dec. | 10/- |
| ,, 19 .. | 19 | 0 | 0 | No change | |
| ,, 22 .. | 19 | 5 | 0 | inc. | 5/- |
| ,, 23 .. | 19 | 5 | 0 | No change | |
| ,, 24 .. | 19 | 5 | 0 | ,, | ,, |

## AVERAGE MONTHLY PRICES OF STEEL RAILS.

| Year. | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Yearly average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| 1908 .. .. | 6 2 6 | 6 0 0 | 6 0 0 | 5 15 6 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 5 15 0 | 5 10 0 | 5 16 3 |
| 1909 .. .. | 5 5 0 | 5 5 0 | 5 5 0 | 5 0 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 | 5 5 0 |
| 1910 .. .. | 5 5 0 | 5 7 6 | 5 7 6 | 5 7 6 | 5 10 0 | 5 10 0 | 5 10 0 | 5 10 0 | 5 10 0 | 5 10 0 | 5 10 0 | 5 10 0 | 5 8 11½ |
| 1911 .. .. | 5 15 0 | 5 15 0 | 5 15 0 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 12 6 | 5 13 1½ |
| 1912 .. .. | 5 13 1 | 5 15 0 | 5 15 0 | 5 15 7 | 6 1 6 | 6 6 3 | 6 7 6 | 6 8 0 | 6 11 3 | 6 12 6 | 6 12 6 | 6 13 9 | 6 4 4 |
| 1913 .. .. | 6 15 0 | 6 14 4½ | 6 12 6 | 6 12 6 | 6 12 6 | 6 12 6 | 6 12 6 | 6 12 6 | 6 10 0 | 6 10 0 | 6 10 0 | 6 10 0 | 6 12 0 |
| 1914 .. .. | 6 10 0 | 6 10 0 | 6 6 3 | 6 0 0 | 6 0 0 | 6 0 0 | 5 14 0 | 6 2 6 | 6 13 9 | 6 12 0 | 6 7 6 | 6 7 6 | 6 5 3½ |
| 1915 .. .. | 6 10 6 | 6 17 6 | 7 5 0 | 7 12 6 | 7 12 6 | 7 17 6 | 8 17 6 | 9 2 6 | 9 2 6 | 9 2 6 | 9 7 6 | 10 10 6 | 8 6 6½ |
| 1916 .. .. | 10 19 4 | 11 0 0 | 11 0 0 | 10 18 9 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 9 10 |
| 1917 .. .. | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 |
| 1918 .. .. | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 | 10 17 6 |
| 1919 .. .. | 10 17 6 | 13 7 6 | 13 7 6 | 13 7 6 | 15 0 0 | 15 10 0 | 16 0 0 | 16 10 0 | 16 10 0 | 16 10 0 | 16 10 0 | 17 5 0 | 14 12 11 |
| 1920 .. .. | 18 15 0 | 19 5 0 | 20 7 6 | 22 0 0 | 23 0 0 | 23 0 0 | 24 0 0 | 25 0 0 | 25 0 0 | 25 0 0 | 25 0 0 | 25 0 0 | 22 18 11½ |
| 1921 .. .. | 23 5 0 | 20 4 0 | 18 0 0 | 17 0 0 | 15 0 0 | 15 0 0 | 14 0 0 | 14 0 0 | 14 0 0 | 11 12 6 | 10 10 0 | 10 0 0 | 15 4 3 |
| 1922 .. .. | 9 10 0 | 9 10 0 | 9 10 0 | 9 10 0 | 9 10 0 | 9 10 0 | 9 10 0 | 9 0 0 | 8 15 0 | 8 15 0 | 8 15 0 | 8 15 0 | 9 4 2 |
| 1923 .. .. | 8 17 6 | 9 2 0 | 10 5 0 | 10 10 0 | 10 10 0 | 10 10 0 | 9 15 0 | 9 0 0 | 8 15 0 | 8 15 0 | 8 19 0 | 9 5 0 | 9 9 10 |
| 1924 .. .. | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 5 0 | 9 2 6 | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 9 2 3½ |
| 1925 .. .. | 9 0 0 | 9 0 0 | 9 0 0 | 9 0 0 | 8 15 0 | 8 10 7½ | 8 10 0 | 8 10 0 | 8 10 0 | 8 4 0 | 8 0 0 | 8 0 0 | 8 11 7½ |
| 1926 .. .. | 8 0 0 | 8 0 0 | 8 0 0 | 8 0 0 | 8 0 0 | 8 0 0 | 8 0 0 | 8 7 6 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 3 11½ |
| 1927 .. .. | 8 10 0 | 8 10 0 | 8 10 0 | 8 2 6 | 8 2 6 | 8 2 6 | 8 2 6 | 8 2 6 | 8 2 6 | 8 3 0 | 8 5 0 | 8 5 0 | 8 4 10 |
| 1928 .. .. | 8 5 0 | 8 5 0 | 8 5 0 | 8 5 9 | 8 6 3 | 8 6 3 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 7 9½ |
| 1929 .. .. | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 |
| 1930 .. .. | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | 8 10 0 | — | — | — | — | — |

## AVERAGE MONTHLY PRICES OF EAST COAST HEMATITE AT MIDDLESBROUGH.

| Year. | Jan. | Feb. | March | April | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Average. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. | s. d. |
| 1915 .. .. | 83 11 | 88 6 | 94 8 | 107 0 | 102 6 | 101 3 | 98 9 | 98 7½ | 96 6 | 104 0 | 124 1 | 130 0 | 106 11½ |
| 1916 .. .. | 133 9 | 140 0 | 136 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 128 1½ |
| 1917 .. .. | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 |
| 1918 .. .. | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 | 122 6 |
| 1919 .. .. | 122 6 | 122 6 | 122 6 | 122 6 | 179 2 | 190 0 | 197 6 | 200 0 | 200 0 | 200 0 | 200 0 | 200 0 | 171 4 |
| 1920 .. .. | 220 0 | 220 0 | 240 0 | 260 0 | 260 0 | 260 0 | 260 0 | 260 0 | 260 0 | 260 0 | 260 0 | 260 0 | 251 8 |
| 1921 .. .. | 240 0 | 220 0 | 180 6 | 180 0 | 180 0 | 160 0 | 160 0 | 160 0 | 137 0 | 127 6 | 117 6 | 104 6 | 162 2 |
| 1922 .. .. | 97 6 | 91 7½ | 100 0 | 98 6 | 97 1½ | 94 7 | 93 6 | 90 9 | 89 7 | 91 10½ | 93 0 | 93 2 | 94 5½ |
| 1923 .. .. | 94 6 | 104 9 | 122 0 | 126 10½ | 122 0 | 115 3 | 107 0 | 98 8½ | 98 10½ | 99 1½ | 100 6½ | 102 3 | 107 10½ |
| 1924 .. .. | 102 4½ | 101 3 | 99 7½ | 99 0 | 98 9½ | 97 4½ | 95 3½ | 93 1½ | 90 7½ | 88 0 | 88 4½ | 88 5 | 95 2½ |
| 1925 .. .. | 87 5 | 85 9 | 84 7½ | 82 6 | 80 10½ | 79 3 | 77 1 | 75 7½ | 75 0 | 74 3½ | 74 9 | 76 0 | 79 5½ |
| 1926 .. .. | 77 3 | 77 9 | 77 3½ | 76 3 | 77 4½ | 78 0 | 79 8½ | 81 9 | 83 4½ | 87 7½ | 92 6 | 90 5½ | 81 7½ |
| 1927 .. .. | 90 0 | 90 0 | 86 3½ | 83 1½ | 80 6 | 78 0 | 76 6 | 75 4½ | 75 0 | 72 9 | 71 9 | 71 1½ | 79 2½ |
| 1928 .. .. | 69 7½ | 69 7½ | 69 9 | 70 0 | 70 0 | 69 3 | 68 7½ | 69 2 | 70 0 | 70 0 | 70 3 | 71 0 | 69 9½ |
| 1929 .. .. | 71 6 | 72 0 | 73 6 | 74 0 | 74 0 | 74 1½ | 74 9 | 75 6 | 76 1½ | 76 8½ | 78 1½ | 79 0 | 74 11½ |
| 1930 .. .. | 78 2½ | 78 0 | 76 9 | 75 0 | 74 0 | 72 7½ | 71 0 | 71 0 | — | — | — | — | — |


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***(A remittance should accompany instructions.)***

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FOR Sale, the Goodwill, including all drawings and patterns of moulding machines and foundry requisites, also iron and non-ferrous foundries. Offers for the engineering side or foundry side alone will be considered.—Apply, E. T. Peirson & Sons, 16/17, Hertford Street, Coventry.

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FOR Sale, Portable Sandslinger, very little used.—Further particulars from Paisley Foundry, Abbotsinch, Paisley.

SAND MIXERS.—New and Secondhand. Ask us to quote.—W. Brealey & Company, Limited, Prospect Works, Hawksley Avenue, Sheffield.

ELECTRO-MAGNETIC Separator Pulley Equipment, studded-belt pattern, 4-ft. centres, dynamo 110 volts, suitable foundry sand, slag, etc. Also Alldays & Onions Blower, 12-in. outlet, good condition, £10.—Box 604, Offices of The Foundry Trade Journal, 49, Wellington Street, Strand, London, W.C.2.

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One 5-ton Geared Ladle.
One 6-ton Geared Ladle.

CORE-DRYING BOGIE.

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UNGER 8-in. x 32-in. Universal Grinder.
LOEWE 10-in. x 10-ft. Plain Grinder.
LANDIS 12-in. x 42-in. Plain Grinder.
NORTON 16-in. x 72-in. Plain Grinder.
Four 30-cwt. "COLES" STEAM TRAVELLING GANTRY JIB CRANES, each constructed to lift 30 cwts. at 42-ft. radius; 50-ft. steel jibs; all motions; 120 lbs. w.p.; specially constructed to hoist and derrick at high speed.
400 STEAM WINCHES, having cylinders from 4½ in. to 10 in. dia.; single- and double-purchase type; ready for prompt despatch.
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One 8-n.h.p. PORTABLE STEAM ENGINE AND BOILER.
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ALBION WORKS, SHEFFIELD.

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